ıOBER, 1958

RUBBER WORLD

SERVING THE RUBBER INDUSTRY SINCE 1889

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PORE SIZES AND DISTRIBUTION IN REINFORCING PIGMENT PARTICLES

By Andries Voet, page 63

RUBBER WORLD, October, 1958, Vol. 139, No. 1. Published monthly by BILL BROTHERS PUBLISHING CORP. Office of Publication, 3rd & Hunting Park Ave., Philadelphia 40, Pa., with Editorial and Executive Offices at 630 Third Avenue, New York 17, N. Y., U. S. A. Second Class Postage Paid at Philadelphia, Pa. under the act of March 3, 1879. Subscription United States $5.00 per year; Canada $6.00; All other countries $7.00. Single copies 50¢. Address Mail to N. Y. Office.

RUBBER WORLD

ARTICLE HIGHLIGHTS

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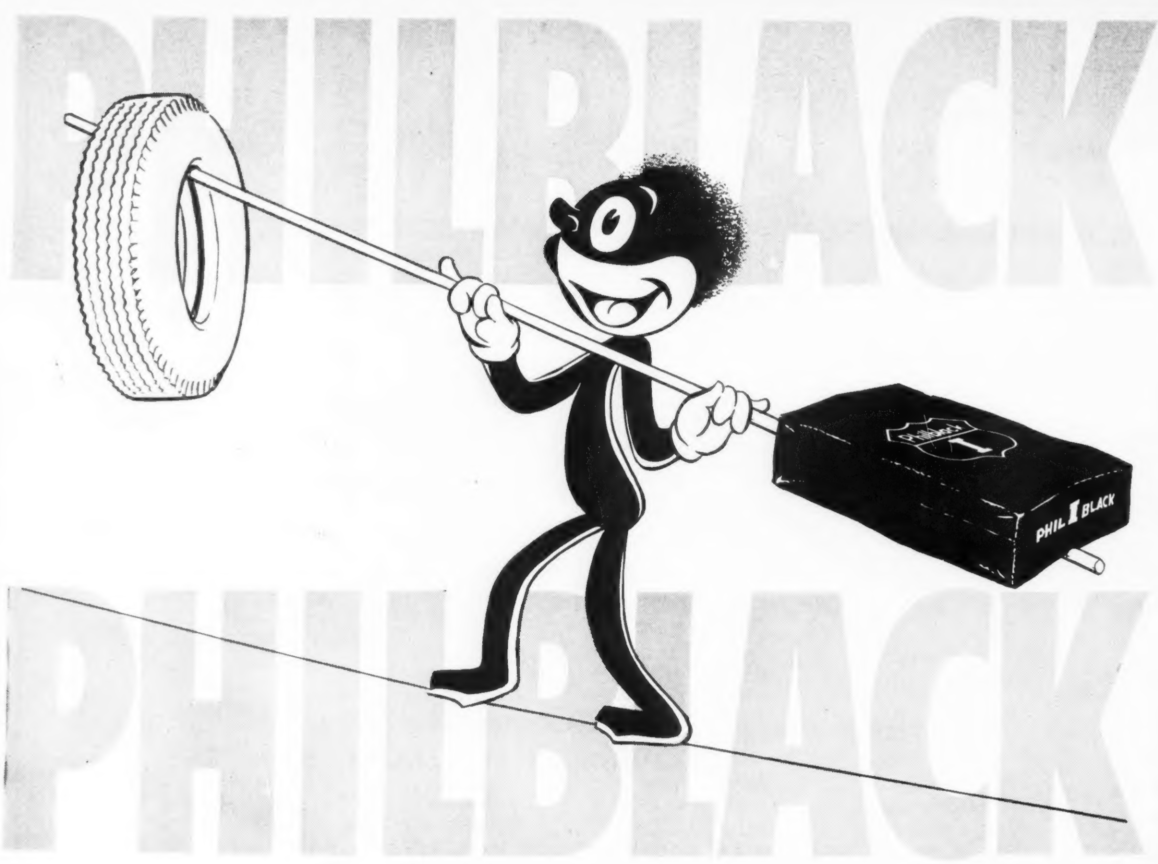
Cover: RUBBER WORLD photo

The opinions expressed by our contributors do not necessarily reflect those of our editors

FEATURE DEPARTMENTS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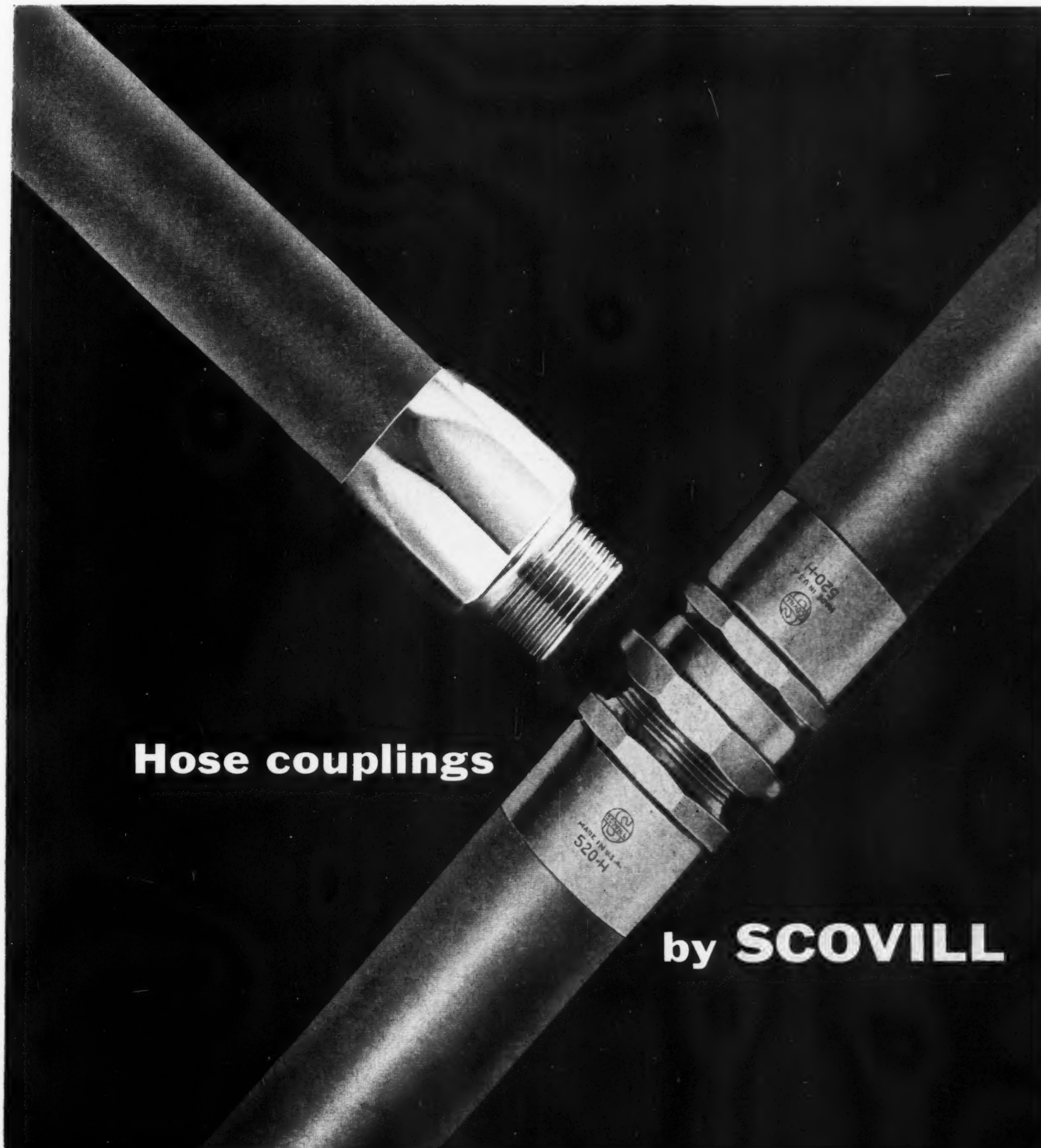
New way to cut costs, increase profits:

PERMANENTLY-ATTACHED HOSE COUPLINGS

Scovill's permanently-attached fuel oil and gasoline pump hose couplings can save you money by eliminating the unnecessary . . . the **hidden** . . . costs of re-attachable couplings. These unseen costs include such expenses as removal-time of old hose couplings, storage, shipping, paper work, re-attachment, and many more.

Hidden costs added to the **higher initial cost** of re-attachable couplings mean one thing: it will actually cost you **less** to throw away a used Scovill permanently-attached coupling than to recondition a re-attachable coupling for re-use.

It's easy to see Scovill permanently-attached couplings save **all along the line.** For full details on the advantages and savings of modern permanently-attached hose couplings write: Scovill Manufacturing Company, Hose Coupling Department, Waterbury 20, Connecticut.



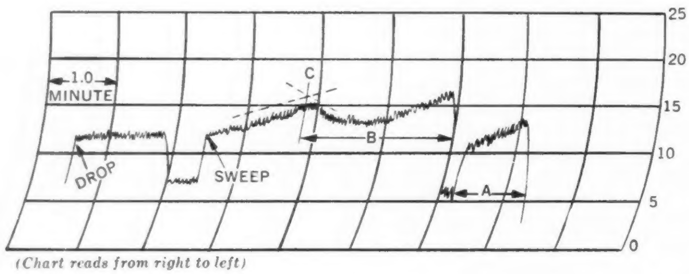
on its way to you!

SOMETHING REALLY NEW AND DIFFERENT
IN STYRENE/BUTADIENE RUBBERS:

Now—for the first time—you

PROCESSABILITY TEST

Hypothetical Processability Test Chart



A. Polymer breakdown time interval **B.** Pigment incorporation time interval

C. Point of complete pigment incorporation

That's right! For the first time–in any rubber–you can be sure of processability – bale after bale, shipment after shipment.

How? Simply by specifying PLIOFLEX for all your styrene rubber needs.

Why? Because Goodyear, through refinement of a previously developed test, has been able to establish a new control over processability.

Here's how it works: A laboratory Banbury is loaded with the polymer to be tested, under a specific set of operating conditions. The polymer is masticated. Then certain pigments are added and the time for their incorporation carefully determined.

Pigment incorporation is the chart-indicated

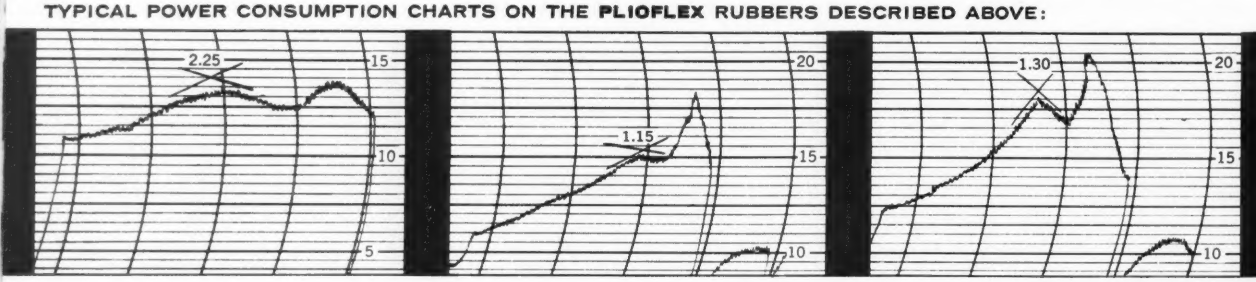
And here are typical PLIOFLEX rubbers with their **A**ssured

PLIOFLEX 1006: A hot, nonextended, fast-curing rubber—protected by a nonstaining, non-discoloring antioxidant—used in white sidewall tires, shoe soles, housewares, toys, sporting goods, flooring and many other products where light color is important. **APF**—2.40

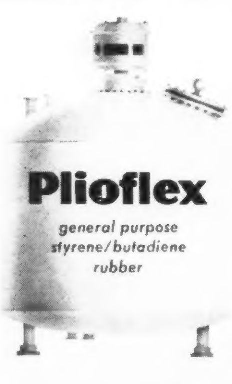
PLIOFLEX 1500: A cold, nonextended, easy-processing rubber—protected by a staining antioxidant – exhibits higher-abrasion resistance, tensile and modulus than corresponding hot rubbers—used in camelback, tires, molded and extruded goods where color is not a factor. **APF**—1.25

PLIOFLEX 1502: A cold, nonextended, light-colored rubber—protected by a non-staining antioxidant—used in white sidewall tires, shoe soles, mechanical goods and items where easy processing, excellent physical properties and minimum discoloration are required. **APF**—1.40

TYPICAL POWER CONSUMPTION CHARTS ON THE **PLIOFLEX** RUBBERS DESCRIBED ABOVE:



PLIOFLEX + Assured Processability



GOOD

CHEMICAL

IN ADDITION TO ASSURED PROCESSABILITY—

Here are eight more big reasons for specifying

Plioflex:

Outstanding research facilities

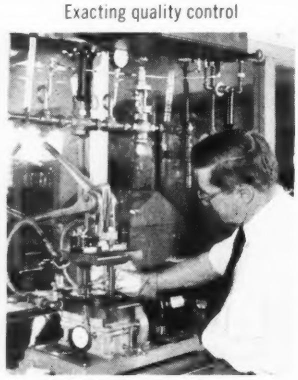
Extensive sales-service laboratories

Technically trained representatives

Comprehensive technical literature

The world's largest dry-rubber plant

Exacting quality control



Strategically located warehouses

Prompt, palletized shipments

Plioflex—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

There are other reasons, too—

Once you've tried PLIOFLEX, you'll find a number of other reasons for continuing its use. So why not get the full story today? Just contact your nearest Goodyear Chemical Division Office listed below. Or write Goodyear, Chemical Division, Dept. V-9418, Akron 16, Ohio.

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Phone: Underhill 1-3773

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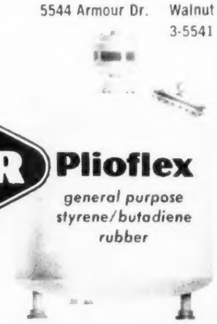

Plioflex
general purpose styrene/butadiene rubber

PROGRESS UNDER PRESSURE—Typical of Southern Railway's emphasis on progress, safety and modernization is a unique, four-mile compressor system installed in its yards in Birmingham, Alabama. Air hoses similar to the one shown are spaced at 1000 ft. intervals and are fed by means of a 4" pipe from a central compressor reservoir. When three or more of these hose extensions are hooked up to a freight train, the necessary air pressure can be built up in much less time than by charging with pressure generated from the locomotive. Another important advantage to this independent source of air pressure is that it permits the discovery and repair of line leaks before the engine is coupled to the train, thus minimizing the possibility of expensive delays. The hose used for this air pressure system was supplied by Carolina Rubber Hose Company and made from Mount Vernon duck.

This is another example of how fabrics made by Mount Vernon Mills, Inc. and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

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AMOCO CHEMICALS—A NEW RESOURCE

How to reduce cost, improve storage stability of vinyl plastisols

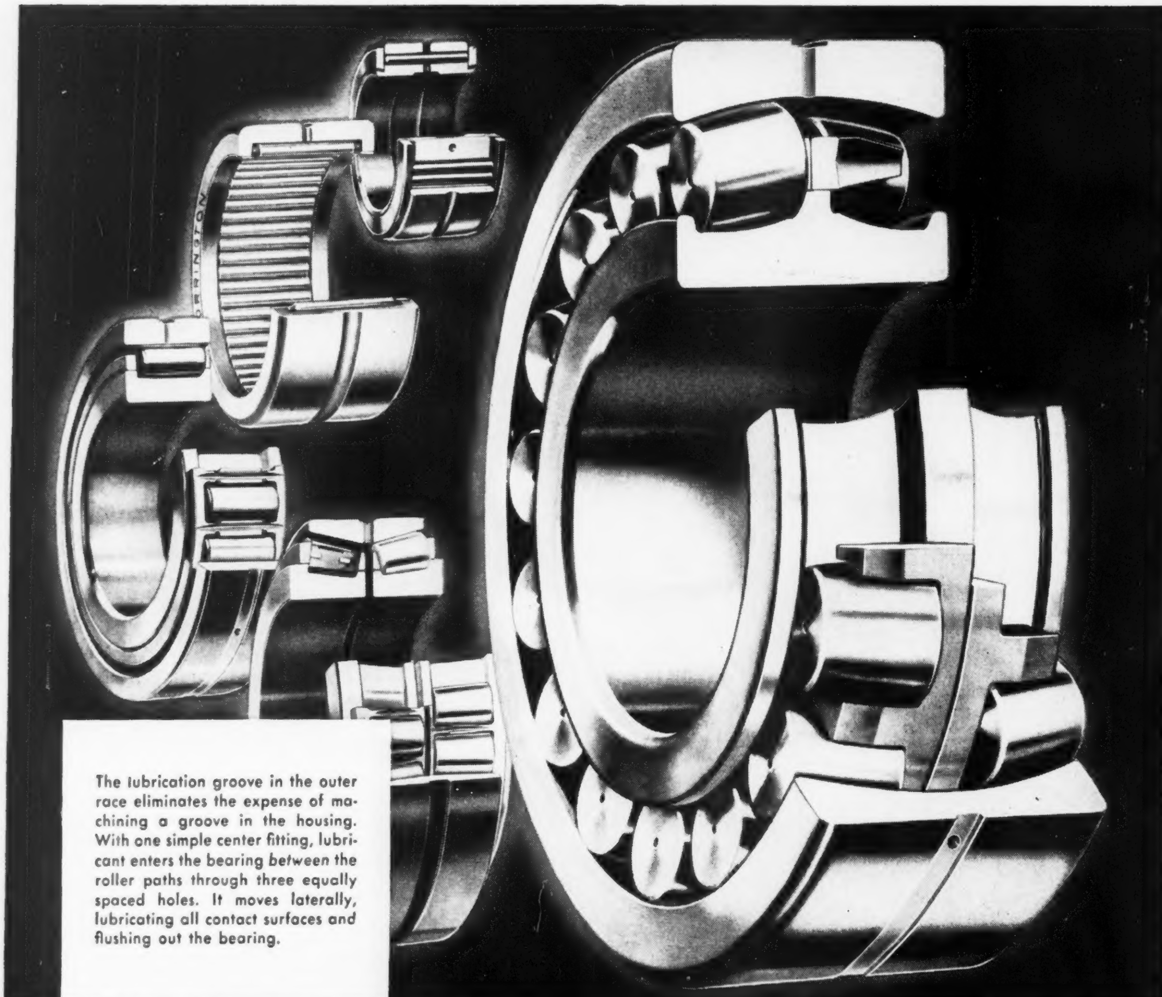
Manufacturers of plastisols for expendable uses—sealants, dip-coated parts, foam, sponge, etc.—and other large-volume, low-cost applications can reduce costs by using PANAFLEX BN-1 as a secondary plasticizer. And PANAFLEX BN-1 can help improve storage stability of plastisols. In a test of storage stability over a 50-day period at a temperature of 115° F., PANAFLEX BN-1 demonstrated superior ability to reduce plastisol viscosity build-up.

PANAFLEX BN-1 is a hydrocarbon plasticizer. It is compatible with vinyl chloride polymers and copolymers. Electrical properties are excellent. Volatility and color stability are comparable to the best hydrocarbon plasticizers.

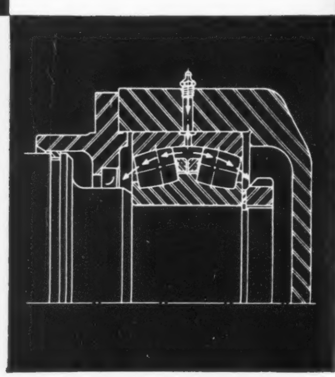
More facts about PANAFLEX BN-1 as a secondary plasticizer in plastisols are ready for you. Send for them. Your request will receive an immediate reply.

AMOCO CHEMICALS

AMOCO CHEMICALS CORPORATION
910 South Michigan Ave., Chicago 80, Illinois



The lubrication groove in the outer race eliminates the expense of machining a groove in the housing. With one simple center fitting, lubricant enters the bearing *between* the roller paths through three equally spaced holes. It moves laterally, lubricating all contact surfaces and flushing out the bearing.



A time-proved lubricating method now available on Torrington Spherical Roller Bearings

The circumferential groove in the outer race has met the test of experience in many Torrington Bearings, including Heavy Duty Needle Bearings, Aircraft Type Needle Bearings, Tapered and Radial Roller Bearings. Now the circumferential lubrication groove is available in Torrington Spherical Roller Bearings.

This design feature makes it possible to introduce lubricant *between* the roller paths without the expense of machining a groove in the housing. This groove is proportioned to provide generous lubricant flow capacity. Lubricant moves through the roller paths, flushing used lubricant and contaminants away from bearing contact surfaces.

Torrington Spherical Roller Bearings in many sizes may be ordered with this groove as desired at no additional cost. For further information, see your Torrington representative or write: **The Torrington Company, South Bend 21, Ind.—and Torrington, Conn.**

TORRINGTON BEARINGS

District Offices and Distributors in Principal Cities of United States and Canada

SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • NEEDLE • BALL • NEEDLE ROLLERS • THRUST

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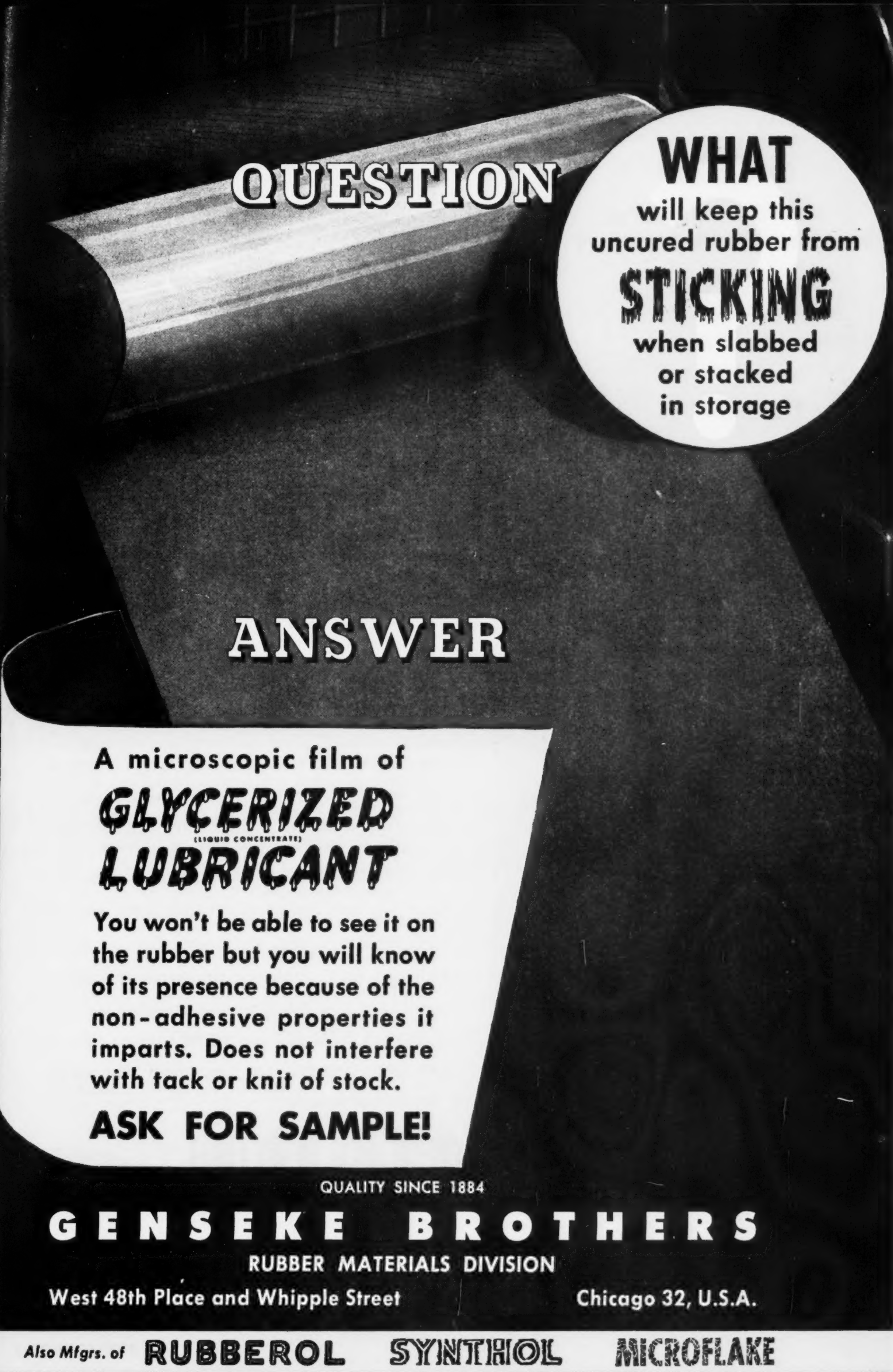
QUESTION
WHAT
will keep this
uncured rubber from
STICKING
when slabbed
or stacked
in storage
ANSWER
A microscopic film of
GLYCERIZED
(LIQUID CONCENTRATE)
LUBRICANT
You won't be able to see it on the rubber but you will know of its presence because of the non-adhesive properties it imparts. Does not interfere with tack or knit of stock.
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SPECIFY BAYTOWN MASTERBATCHES FOR SATISFACTION AND ECONOMY

BAYTOWN MASTERBATCHES fundamentally consist of cold rubber, or oil extended rubber, and carbon black.

BAYTOWN MASTERBATCHES are formulated specifically for your preference as to polymer, oil extension, emulsifier, carbon black and antioxidant — all in the types and percentages you desire.

BAYTOWN MASTERBATCHES are scientifically produced to provide an intimate and homogeneous dispersion of the carbon black.

BAYTOWN MASTERBATCHES are widely used in many applications. Their unsurpassed quality and long-established reputation for uniformity affirm their leadership in black masterbatches and oil-black masterbatches.

SYNTHETIC BAYTOWN RUBBER

UNITED CARBON COMPANY, INC.

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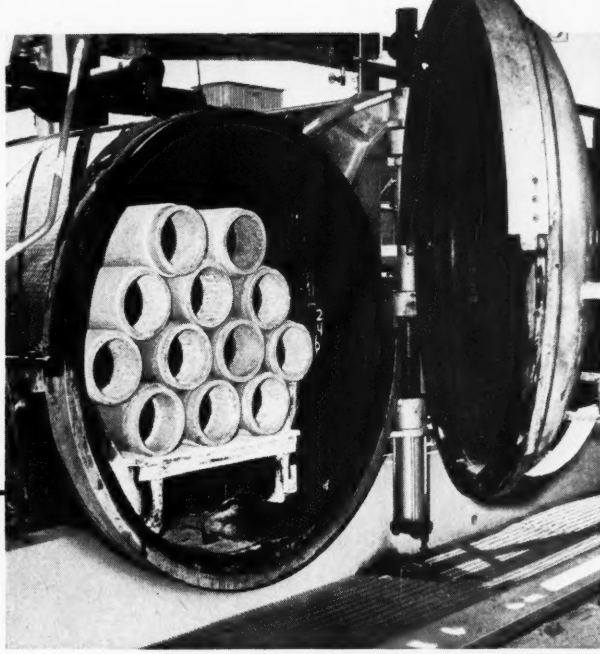
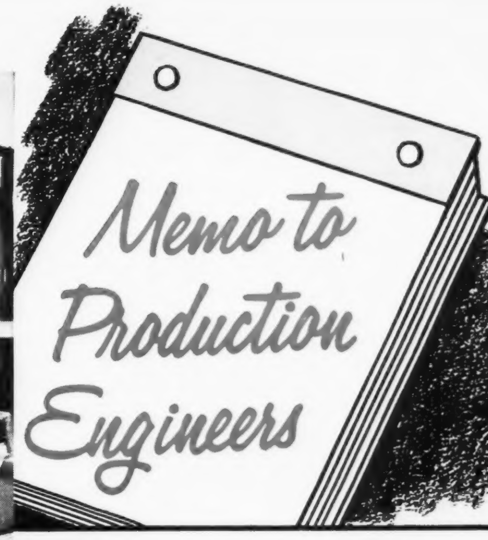
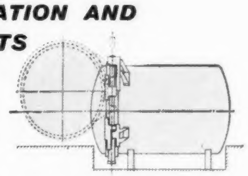




◀ Adamson 90" dia. Hi-Lift Swing Door installed at Johns-Manville Products Corporation, Manville, N. J. One of many Adamson doors now in operation, or on order, for use in steam-curing TRANSITE® Pipe at J-M Plants in the U. S. and Canada.

Here are 6 important reasons why you should specify ADAMSON UNITED Hi-Lift Swing Vulcanizer & Autoclave Doors

1 LOWER INSTALLATION AND OPERATING COSTS



Adamson's lift-swing feature eliminates need for extended pit and expensive bridging. For example, on a 90" dia. door you can use an easily-handled loading bridge as short as 22".

2 TIGHT, LEAKPROOF SEAL

Adamson's special heat-resistant, self-sealing gasket utilizes vessel's internal pressure to assure a positive, leakproof seal.

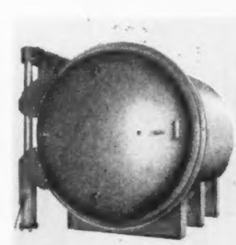
3 EFFICIENT SLIDE-LOCK DESIGN

Provides virtually 360° of locking surface between door and mating shell ring. *Twice* the locking area of conventional breech-lock doors!

4 SAFE, RELIABLE OPERATION

Equipped with automatic door locking pins. Can be furnished with optional steam interlock controls for complete safety. Other built-in safety features included.

5 STRONGER CONSTRUCTION



Conventional castings are replaced by sturdy pressed steel head welded to continuous roll forged locking rings.

6 FAST OPENING AND CLOSING

Quick-unlocking, vertical-lift action powered by hydraulic cylinder. Door swings easily on anti-friction and bronze sleeve bearings. Simple, trouble-free operation.

7067

ADAMSON UNITED
COMPANY

We offer a wide range of door sizes and pressures, available as integral equipment on vessels supplied by us, or as separate units for mounting on tanks made by other manufacturers. Write for catalog No. 562.

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Subsidiary of United Engineering and Foundry Company

Plants at Pittsburgh, Vandergrift, Wilmington, Youngstown, Canton

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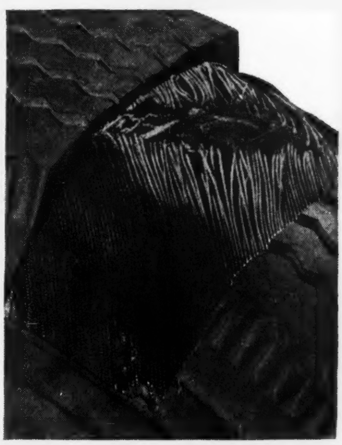
Lucky it's

. . .

GEN—TAC!®

. . . FREEZING WON'T RUIN THIS CARGO!

That's right! Even when frozen and thawed, Gen-Tac's outstanding quality remains unaffected. When subjected to freezing temperature for hours at a time, Gen-Tac won't break down. Gen-Tac, General's proven vinyl pyridine latex, has excellent freeze stability, and assures the best fabric-to-rubber adhesion in tires and other applications. Write for literature and samples to The General Tire & Rubber Company, Chemical Division, Akron, Ohio.



Moisture degradation — Gen-Tac keeps this from happening to your tires. Cord treated with Gen-Tac adheres to rubber so well that moisture doesn't "wick" in to loosen the cords.

Curing blows—Gen-Tac cuts curing blows like this to a minimum because it is fast-curing and develops its strength in the early stages of cure when internal pressures do the most harm.

WITH GEN-TAC   WITHOUT GEN-TAC

Adhesion—Gen-Tac treatment of tire fabric provides adhesion-to-rubber strength greater than the strength of the surrounding stock itself.

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Chemical Division

AKRON, OHIO

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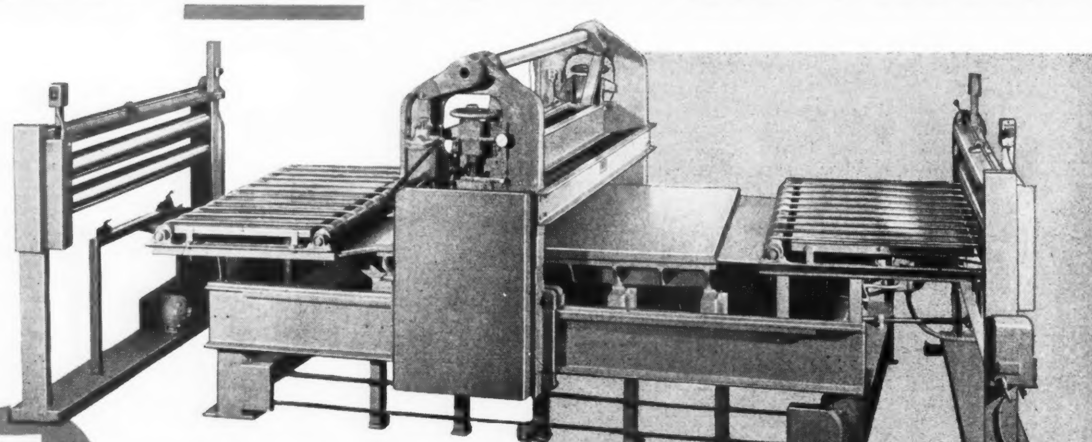
2 New *FEMCO Machines with One Idea in Mind—

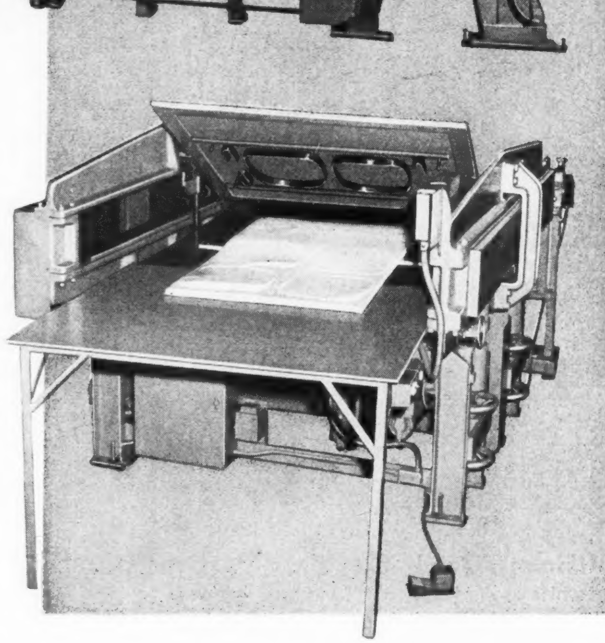
BOOST YOUR DIE CUTTING PROFITS!



1 AUTOMATIC "Roll Feed" DIE CUTTER*

For Die Cutting Roll Stock automatically, accurately and fast you should investigate the new 84" x 72" FEMCO "Roll Feed" Die Cutter shown above. It handles such diversified padding, covering and cushioning stocks as supported and unsupported Vinyl Fabrics; Polyether Foam; supported Foam Rubber; Fiberglass; Curled Hair; "Tufflex" and other materials. It cuts fast—turning out perfect pieces in a 10-second cutting cycle.

Power driven feed rolls and imput conveyor draw the festooned stock into cutting position on the 42 square foot bed area. Steel rule dies are mounted either on the bed plate or on a new Die Handling mechanism which raises vertically above the bed plate. Dial-set roll pressure virtually eliminates costly "set-up" time. You push a button, the Die Cut is made and output conveyor and pinch rolls pull the Die Cut material and scrap off the cutting area, and a new cut starts. Write for complete specifications and a quotation today!



2 Heavy Duty ROLLER DIE CUTTER* *with*

new Vertical Die Handling Mechanism

Here is a FEMCO 60" x 48" Heavy Duty Roller Die Cutter (above right) equipped with a new Die Handling mechanism which greatly expands the machine's potential use in Die Cutting thick materials.

This equipment successfully Die Cuts Polyether to 4" thickness; Foam Rubber to 2"; close cell Sponge to ½" thickness; open cell Sponge Rubber, supported and unsupported Vinyl Fabric; supported Foam Rubber; Cork Composition Gaskets; Abrasive Paper; Curled Hair; Fiberglas; "Tufflex" padding; rough cut Vinyl Floor Tile; high density Soling and uncured rubber stocks.

Dies are shown mounted in a steel frame positioned vertically above the bed area. When the frame holding the Dies is in the extreme upward position shown here it is 30" from the bed plate for easy loading and unloading of thick slab material, and to allow roll stock to move easily across the bed. When the die frame is automatically lowered into cutting position, the roller passes over the back of the Die Board, instead of directly over the dies and material.

Send us samples of your own stock and we will make trial cuts without obligation, giving you a detailed report on what FEMCO machines can do for you.

***Campbell Designed Machines**

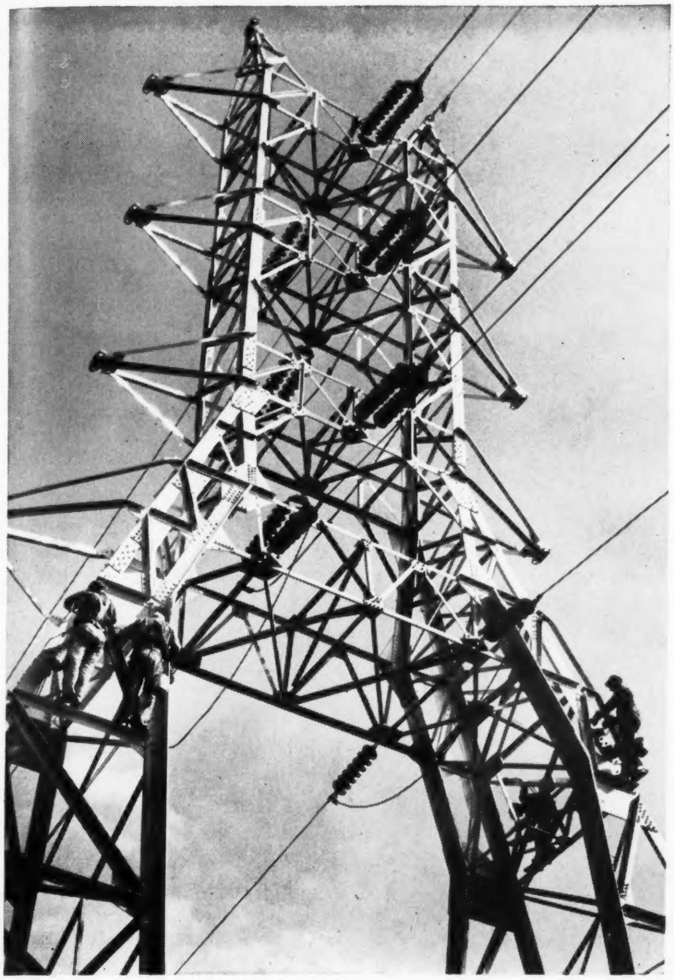
1917 41st YEAR OF SERVICE 1958

The FALLS ENGINEERING AND MACHINE CO.

CUYAHOGA FALLS, O.

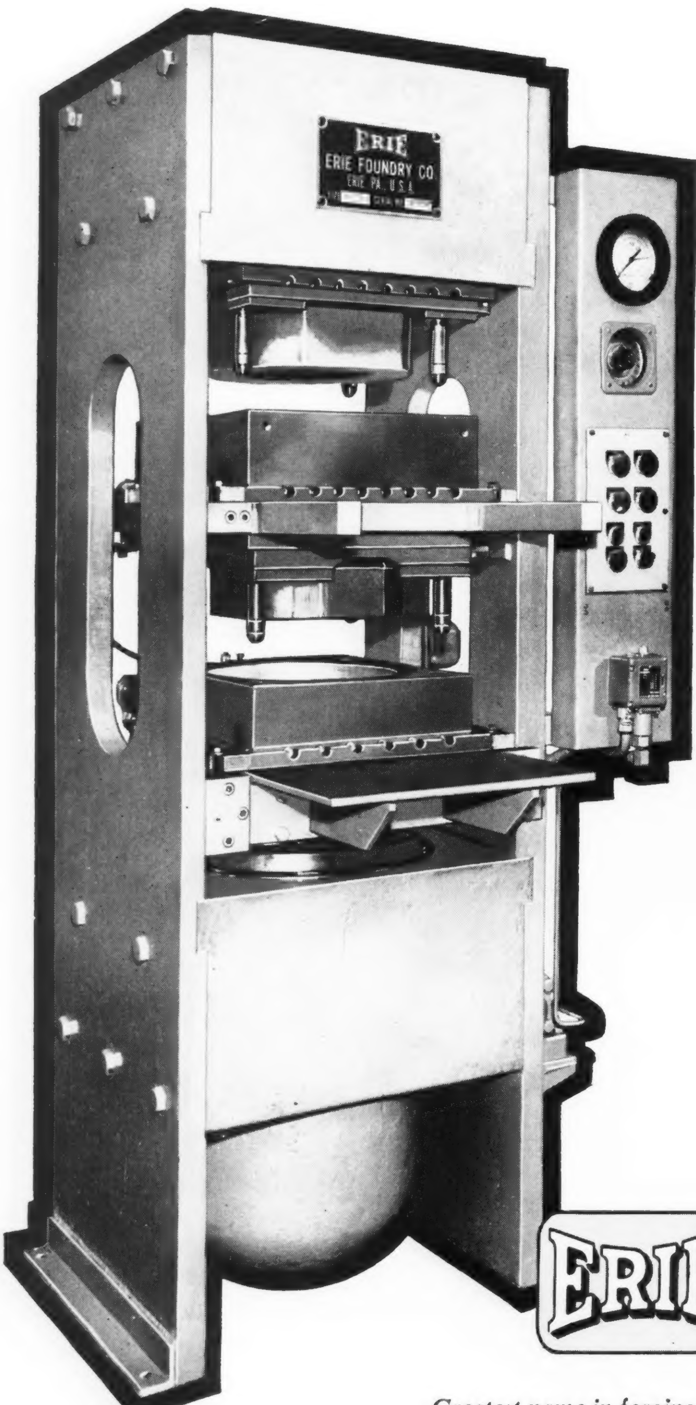
Write for information on FEMCO's new "FEF" Plan—a machinery financing arrangement which lets you pay as you profit. Also write or call to see movies in sound and color in your office showing our equipment in action.


U.S. AIR



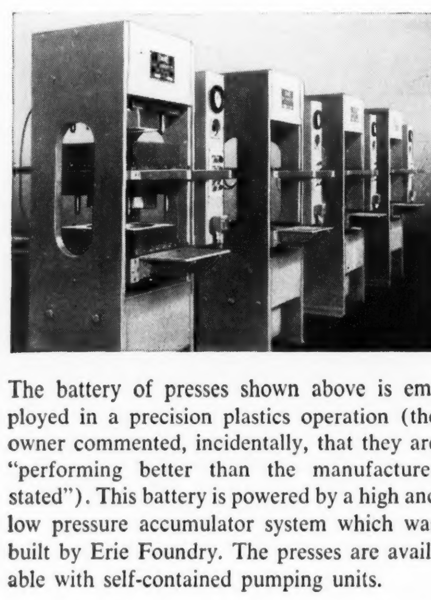

New SYNPOL
Ultra-Dispersed
Carbon Black
Masterbatch
COMMERCIALLY PROVED AND
COMMERCIALLY AVAILABLE
NOW

this ERIE press "stands out" for low-cost molding



If you're molding plastics or thermo-setting materials, you can boost profits by including Erie presses like these in your operation. Of side plate construction, with two 15″ openings, this machine is up-acting, has a 14″ main ram with a 16″ stroke.

Semi-automatic in operation, this Erie press features a die-slide arrangement and accurate action that holds scrap loss to absolute minimums. Low maintenance costs and overall savings in operation make these presses ideal for any compression molding operation.



The battery of presses shown above is employed in a precision plastics operation (the owner commented, incidentally, that they are "performing better than the manufacturer stated"). This battery is powered by a high and low pressure accumulator system which was built by Erie Foundry. The presses are available with self-contained pumping units.

We'll be glad to give you full details on this press. Or let us help you with any press problem. There's no obligation. Just call or write...

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Greatest name in forging machinery and hydraulic presses—since 1895

UOP
288
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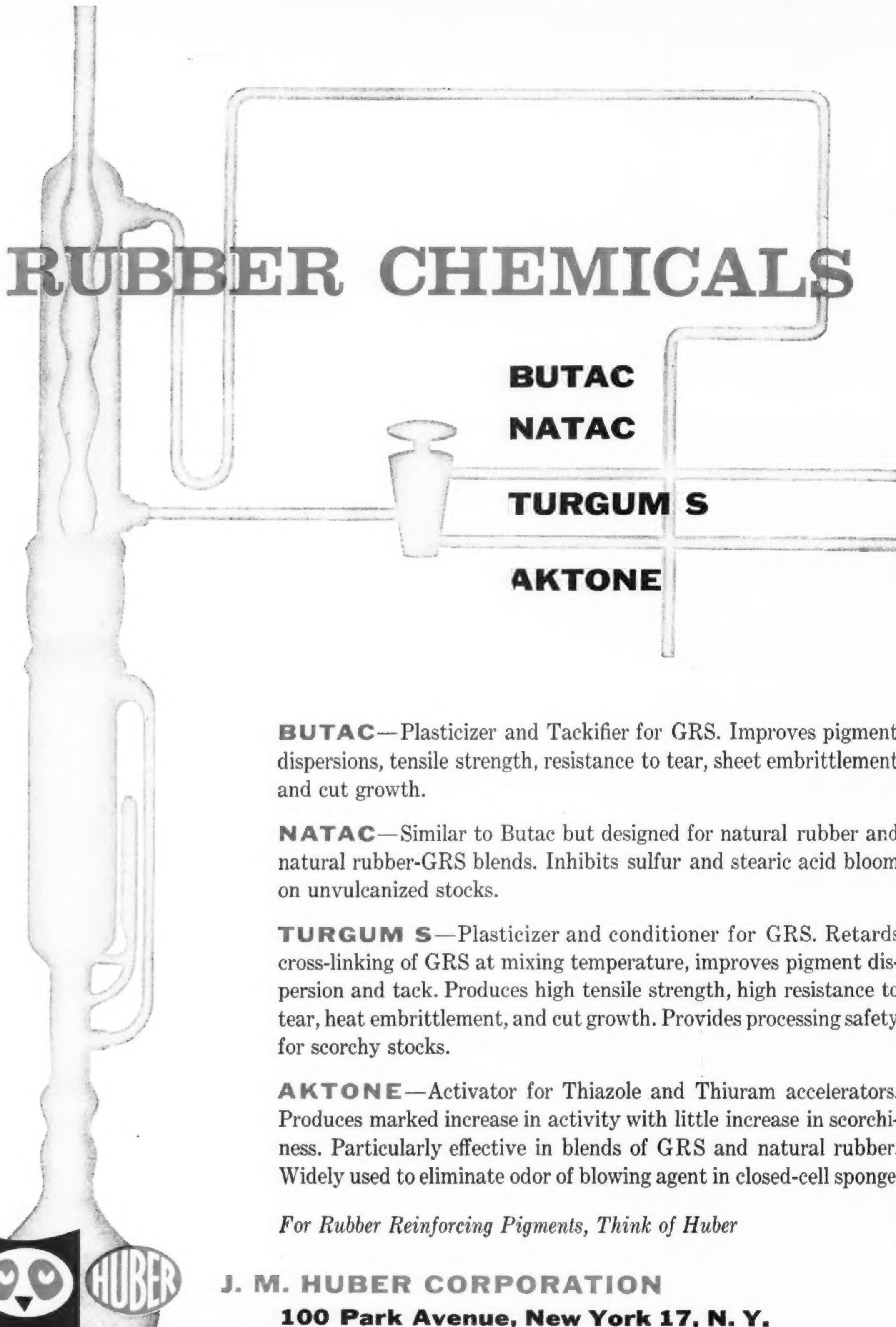

RUBBER WORLD
EDITORIAL

Urgent Need of Adequate Profits To Reverse Research Budget Cuts

THE annual expenditure for research and development in the rubber industry during 1958 is down 2.6% from 1957, according to the results of a recent survey conducted by the American Management Association. Over 800 companies in 24 industries were covered by this survey, and 18 industries showed an increase in budget for research and development ranging from 2% to 26% (transportation equipment); while six industries showed a decline in budget; the greatest reduction was 15% (construction industry).

One of the most important factors for the growth of any industry or company within that industry is the maintenance of an adequate budget for R & D. It is necessary, however, to determine just what represents an adequate R & D budget and then to have adequate sales and profits to justify that budget.

Among the industries reporting an increase in R & D budget for 1958 was the chemical industry, with a 10% rise. The 1957 R & D budget for the chemical industry as % of sales was 3.3, as compared with 2.8 for the rubber industry. These figures may be compared with those presented in this column in February, 1956, when the chemical industry's R & D expenditure for 1953 was estimated at 1.8% of sales, and the comparative figure for the rubber industry was 1.1%.

It is gratifying to note that both the chemical and rubber industries have increased their R & D budgets during recent years. These increases were undoubtedly made possible by the growth in sales and profits experienced during most of that period. Such growth in sales as were attributable to earlier R & D, however, resulted from efforts made several years earlier. Future sales growth requires adequate R & D budgets now, but profits will also have to be increased to provide the necessary funds.

The urgent need of adequate profits in industry in order that industry will be able to provide the new products and services on which the future expansion of our economy depends, was emphasized by John N. Hart, B. F. Goodrich Co. controller, in a talk before the Rotary Club of Akron in late July. In the rubber industry the profits after taxes of the larger manufacturers averaged about 4.4¢ per $1 of sales in recent years. This figure, however, was 25% below the average of 1800 leading companies throughout the county. Sales of the major rubber goods manufacturers during the first quarter of 1958 were about 12% less than in the first quarter of 1957, and profits during the same period were down about 36%.

Although there are increasing evidences of a business upturn after the recent recession, there are some basic economic trends that have prevailed during the past 10 years that will have to be changed if industry's profit margins are to improve. Some of these trends, as pointed out by Mr. Hart, are continuing wage inflation, insufficient depreciation allowances under present tax laws, and the need of money to invest abroad to maintain the United States' share of world markets.

Somehow means must also be found to reverse any trend for reduction of research and development budgets in the rubber industry.

R. G. Seaman
EDITOR

RUBBER WORLD

Pore Sizes and Pore Size Distribution In Reinforcing Pigment Particles–I[1]

By ANDRIES VOET
J. M. Huber Corp., Borger, Tex.

THE presence of pores in the particles of a pigment generally influences its reinforcing characteristics in elastomers. Pores which are too small to allow elastomer molecules to penetrate add to the surface area without contributing to reinforcement. Molecules of accelerators and other rubber chemicals are generally much smaller than rubber molecules and therefore could be removed from the matrix by adsorption in the pores of the reinforcing pigment particles.

While the size of the molecules of processed rubbers is not accurately known, it is thought to be of the order of several hundred Angstrom units.[2] The particle diameters of the most frequently used reinforcing pigments, such as HAF or ISAF carbon blacks, or hydrated silica pigments are in the range of 200-300 Å and therefore could not accommodate elastomer molecules in internal pores. It is very unlikely that molecular segments of elastomers would enter pigment pores, since the quantity of rubber bound by a pigment appears to be proportional to its external surface area as calculated from electron microscopic diameters (1);[3] thus, pores do not contribute to elastomer reinforcement.

Limitations of Existing Methods for Pore Size Determination

Two methods are known for the determination of pore sizes and size distribution in porous substances.

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[1] Presented before the Division of Rubber Chemistry, ACS, Cincinnati, O., May 16, 1958.
[2] An Angstrom unit (Å) is 10^{-8} cm.
[3] Numbers in parentheses refer to Bibliography items at end of this article.

Fabian Bachrach

The Author

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Dr. Voet first joined Huber's ink division in 1943 and attained his present position in 1950. He is a member of the American Physical Society, the American Chemical Society and the Division of Rubber Chemistry, ACS, and is also a Fellow of the New York Academy of Sciences.

Dr. Voet, who was born in Holland, studied chemistry at the University of Amsterdam and was awarded the B.Sc. (1929), M.Sc. (1931), and Ph.D (1935) degrees from that institution.

He has published a number of scientific papers and patents and is the author of "Ink and Paper in the Printing Process," (Interscience Publishers, Inc., New York, 1952).

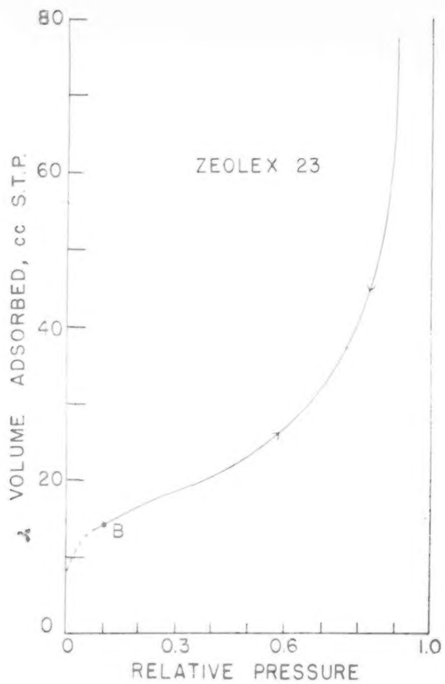

Fig. 1. Nitrogen adsorption isotherms at −196° C. for Zeolex 23

A direct method of obtaining pore volume distribution, by the use of a high-pressure mercury porosimeter, has been described by Ritter and Drake (2). In this method, mercury is forced into the pigment pores under high pressure. Since the smaller the capillary diameter, the higher the pressure required to fill the pore, a capillary size distribution curve may be obtained. Owing to pressure limitations, however, only pore diameters can be measured which are larger than about 70 Å, a range of little significance for the small particles of reinforcing pigments.

A second method is based upon an analysis of gas adsorption and desorption isotherms of the pigments. Adsorption of gases occurs on a flat surface as well as in pores, but capillary condensation is only found in pores.

In this approach, the first step is to determine the surface area of the pigment. This is done by estimating the quantity of a gas required to cover completely a given weight of pigment with a monomolecular layer of the gas. The area of a single gas molecule being known, the total surface area of the pigment is easily computed.

The essential point is to determine the conditions under which a monolayer of the gas is formed. A theory of multilayer gas adsorption has been developed by Brunauer, Emmett, and Teller (3). The relation which they derived, known as the B.E.T. equation, has the following form:

$$\frac{P}{V(P_o - P)} = \frac{1}{V_m C} + \frac{(C-1)}{V_m C} \cdot \frac{P}{P_o} \qquad \text{(A)}$$

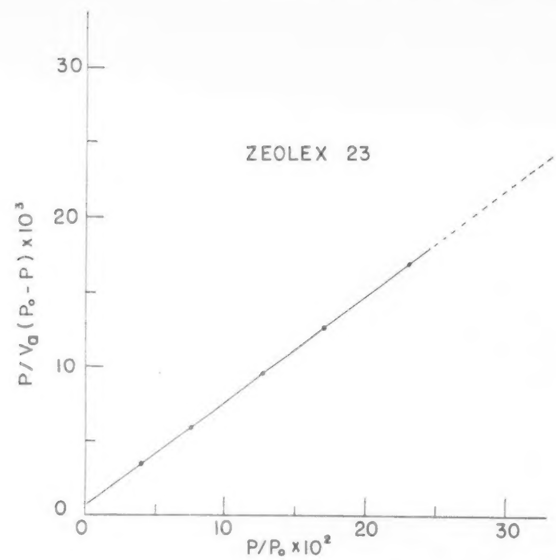

Fig. 2. B.E.T. relation for Zeolex 23 at −196° C.

where P is the gas pressure; P_o the saturation gas pressure; V the volume of gas adsorbed; and V_m the volume of gas adsorbed as a monolayer. C is a constant related to the heat of adsorption.[4] If the left-hand member of the B.E.T. equation is plotted against the relative pressure P/P_o, a straight line is obtained from which V_m can be calculated.

Figure 1 indicates an adsorption isotherm for nitrogen at −196° C. for Zeolex[5] 23, a sodium aluminum silicate reinforcing pigment. This isotherm, known as a Type II isotherm, has an S-shape characteristic of most reinforcing pigments.

By plotting the data according to the B.E.T. equation (A) a relation is obtained, reproduced in Figure 2, which is linear over a limited range. The point at which the monolayer has been filled (Point B), which is indicated on Figure 1, was computed from the B.E.T. relation of Figure 2.

It was found that the desorption isotherm for Zeolex 23 is identical with the adsorption isotherm. Thus, complete reversibility exists for adsorption and desorption with Zeolex 23. The same was found to be true for many reinforcing pigments, except for the highest relative pressure range, which will be discussed later. For some pigments, however, the desorption isotherm falls above the adsorption isotherm, a phenomenon known as desorption hysteresis. For example, Figure 3 indicates this hysteresis phenomenon for a bentonite clay pigment.

Adsorption-desorption hysteresis is related to the presence of capillaries. It is characteristic of porous adsorbents and can be used for the evaluation of pore sizes and pore size distribution in a range above 40 Å.

The physical basis for the evaluation of porosity of

[4] An adsorption isotherm may be measured at any desired temperature. The relative pressure at each temperature is the ratio of the gas pressure at the selected temperature and the saturation pressure (the pressure at which the gas liquefies at the selected temperature).

[5] J. M. Huber Corp., New York, N. Y.

Pore Sizes and Size Distribution in Reinforcing Pigment Particles

The presence of internal pores or capillaries in the particles of pigments may influence their reinfo.cing properties when the p.gments are used in rubber and other elastomers.

First of all, internal pores that are too small to allow elastomer molecules to penetrate them contribute to surface area without enhancing reinforcement, and this condition resu.ts, in a sense, in "an inefficient" pigment. Second.y, these same internal cavities, although too small for elastomer penetration, may trap and effectively remove from the elastomer matrix accelerators, antioxidants, curing agents, and perhaps other compounding ingredients essential to producing a satisfactory vulcanizate. Thus pore size and pore size distribution become an important characteristic of rubber compounding pigments.

The experimenter seeking to elucidate, by nitrogen adsorption and desorption measurements, pigment structure is confronted with many complexities, among which is the mechanism by which small capi.laries fill and empty.

Two distinct types of cap.llaries are recognized: Class I capillaries which fi.l at low nitrogen pressures (below 50% of saturation), and Class II capillaries which fi.l above 50% of saturation. The basic difference between the two is that Class I capillaries do not exhibit desorption hysteresis, while Class II capillaries do.

The new method for evaluating pore size (of the order of 18-40 Å diameters) and pore size distribution is based upon a stepwise analysis of the reduction in nitrogen adsorption by the pigment after correcting for the complete filling of still smaller pores during the adsorption process.

Pore size and pore size distribution data are given for a number of commercially important pigments.

very small particles was developed by Lord Kelvin in 1871. A gas will condense on a flat surface only when the saturation pressure has been reached. In a capillary, however, a gas molecule is subject to attractive forces from both walls, while only from a single wall on a flat surface. Therefore condensation of a gas to a liquid inside a capillary occurs at a pressure somewhat below saturation. It is obvious that the smaller the capillary, the lower the pressure at which condensation occurs.

Kelvin derived a relation between the pore curvature and the saturation pressure from thermodynamics, which is known as the Kelvin equation:

$$-\frac{2\, t_s M}{r_k} = RT \ln \frac{P}{P_0} \qquad \text{(B)}$$

where r_k denotes the radius of curvature (Kelvin radius) of the pore; t_s the surface tension of the liquid; M its molecular volume; R the gas constant; T the absolute temperature; P the saturation pressure of the gas in the capillary; and P_0 the saturation pressure on a flat surface.

For nitrogen at —195° C. this relation simplifies to:

$$r_k = \frac{4.14}{\log \frac{P}{P_0}} \qquad \text{(C)}$$

It now appears that the phenomenon of adsorption-desorption hysteresis is connected with the existence of capillaries. The explanation is as follows. Capi laries fill by formation of successive layers of adsorbed nitrogen, first a monolayer, followed by subsequent adsorbed and condensed gas films. These multilayers will finally merge, and the capillary becomes filled.

Desorption hysteresis occurs because the capillary does not empty in the same manner as it is filled.

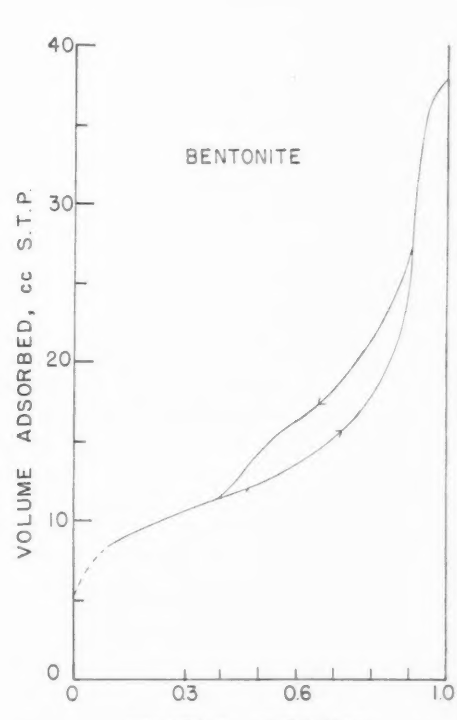

Fig. 3. Nitrogen adsorption-desorption isotherm at —196° C. for a Bentonite clay

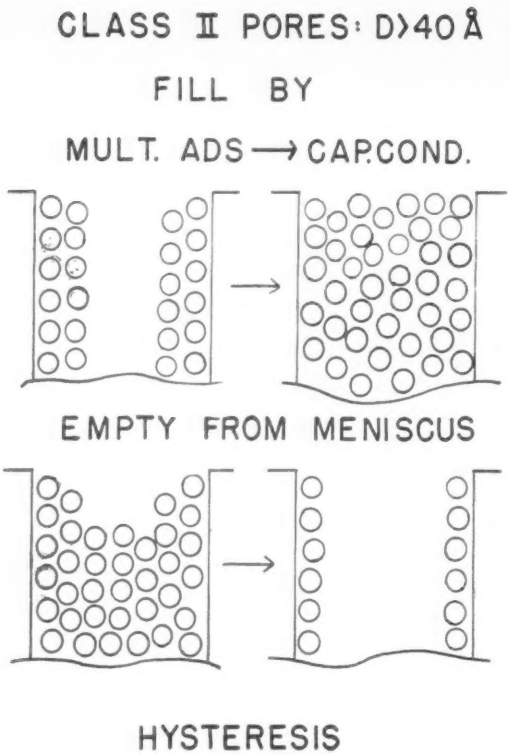

Fig. 4A. Schematic representation of the filling and the emptying of Class II capillaries

It empties by evaporation from the meniscus, in accordance with the physical law of Kelvin, as schematically indicated in Figure 4A. Consequently the gas molecules are more tightly held, by both walls, in the desorption phase. Therefore, the most important conclusion which may be drawn is that where desorption hysteresis occurs, capillaries are present, and the diameter of the capillary can be related to the desorption pressure according to the Kelvin relation, within the range of its validity. We shall neglect the rare instances where swelling of the absorbate causes desorption hysteresis.

The method now generally used for the computation of pore sizes and pore size distribution in pigments employs an analysis of the low-temperature nitrogen adsorption isotherm of the pigment. It is based upon Wheeler's theory (4), which in effect combines the B.E.T. multilayer adsorption idea with a capillary condensation viewpoint. In this theory the pore diameter is considered equal to the sum of the multilayer thickness as calculated from B.E.T. theory and the diameter normally computed from the Kelvin equation. Barrett *et al* (5), as well as Pierce (6), developed a step-by-step calculation of Kelvin radii from desorption data, applying corrections for the multilayer film remaining on the wall after the inner capillary volume is emptied in each relative pressure interval. Thereafter a tabular integration is carried out to obtain the total pore size distribution over the range considered.

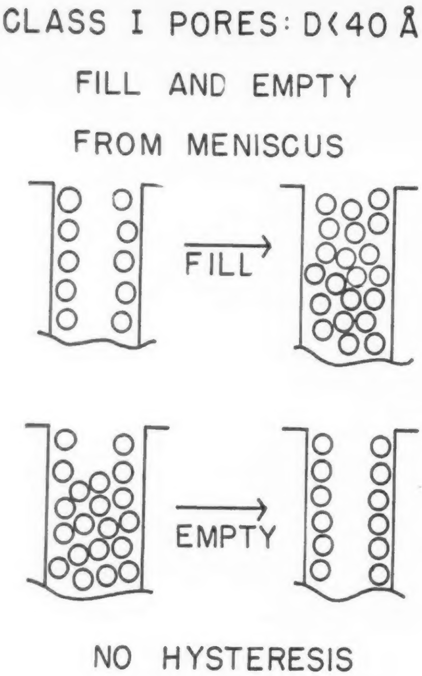

Fig. 4B. Schematic representation of the filling and the emptying of Class I capillaries

On the assumption that the pores are cylindrical and that the Kelvin relation is applicable, pore sizes and pore size distribution have been obtained for porous substances in the pore diameter ranges above about 40 Å (above the significant range of capillaries in reinforcing pigment particles). This approach is not valid for smaller pores, as will be outlined below.

Types of Capillaries

Pierce and Smith (7-8) recognized the existence of two types of capillaries. Class I capillaries fill at lower nitrogen pressures (below 50% of saturation); while class II capillaries fill at pressures above 50% of saturation. The basic distinction between the two classes is that the former do not show any hysteresis on desorption; while the latter do.

The filling of capillaries can occur by two distinct processes: namely, by the condensation of vapor at a meniscus which bridges the walls of the pore, as well as by the building up of a multimolecular film on the walls until the space is filled.

The essential differences between the two classes of capillaries, according to these researchers, are that the small Class I pores fill immediately in the earlier stages of the adsorption; while the larger Class II pores fill by a combination of wall film adsorption and capillary condensation, as previously indicated in Figure 4A. Adsorption and desorption occur in exactly the same manner in the small Class I capillaries, both from a meniscus (Figure 4B). These pores, therefore, do not show any desorption hysteresis. Class II capillaries, however, fill from the walls and empty from a

meniscus and may show hysteresis (9-10).

A more precise conclusion for the conditions governing the phenomenon of hysteresis may be drawn from the work of Cohan (9). It appears that for cylindrical capillaries hysteresis occurs only when the pore diameter is larger than four times the thickness of the adsorbed film without condensate. For nitrogen, where the thickness of the monolayer is 3.6 Å, this limit for the possibility of occurrence of adsorption hysteresis appears to be at a relative pressure of 0.47, since exactly at that pressure the Kelvin pore diameter commences to exceed the theoretical limit of four times the thickness of the film adsorbed by multilayer adsorption. Consequently in the case of nitrogen, hysteresis of the adsorption-desorption isotherms is only to be expected at relative pressures above 0.47.

It is interesting to note that this critical limit depends on the molecular size of the adsorbate molecules and is, for instance, lower for hydrogen and higher for organic molecules such as butane.

The methods indicated for pore size calculations based on desorption isotherms (5-6) are only valid for Class II capillaries which show desorption hysteresis. Since, in the case of nitrogen, hysteresis phenomena can only occur at relative pressures above 0.47, the approach indicated is valid only for capillaries of a diameter of above 40 Å, the corresponding pore diameter range.

Intra- and Inter-Particle Pores

Differentiation must be made between capillarity originating from pores inside particles and the capillary spaces between particles. When small particles are closely packed, the capillary spaces between them act as Class II capillaries. Thus in Figure 5, Curve B demonstrates that a channel black compressed at 25,000 pounds per square inch to a density of 42.6 pounds per cubic foot (corresponding to a void volume of 62.0%) clearly shows the hysteresis curve of inter-particle capillarity down to a relative pressure of about 0.80. This indicates that capillary spaces exist between particles of sizes above 120 Å.

Curve A of Figure 5 shows the same channel black at a density of 5.0 pounds per cubic foot (corresponding to a void volume of 95.5%). In this state hysteresis occurs down to pressures of 91% of saturation and indicates capillary spaces between the particles of sizes larger than 250 Å. There can be no doubt as to the inter-particle nature of these capillaries, since no pores of the sizes indicated could be expected within particles of a diameter of 300 Å.

It must be remarked that the problem of inter-particle capillarity is not found in porous materials, the surface area of which is nearly exclusively an internal surface, such as adsorptive charcoal and similar materials. Such substances, however, do not function as reinforcement pigments in rubber.

Extensive investigations of many rubber reinforcing pigments reveal that with the commonly used materials no hysteresis is encountered in low-temperature adsorption-desorption isotherms below a relative pressure of about 0.80. This indicates that no Class II pores are present in these particles and that all capillarity found at higher relative pressures must be caused by capillary spaces between closely packed particles. At this stage the conclusion must therefore be drawn that conventional pigment particles are either non-porous or have Class I capillaries only.

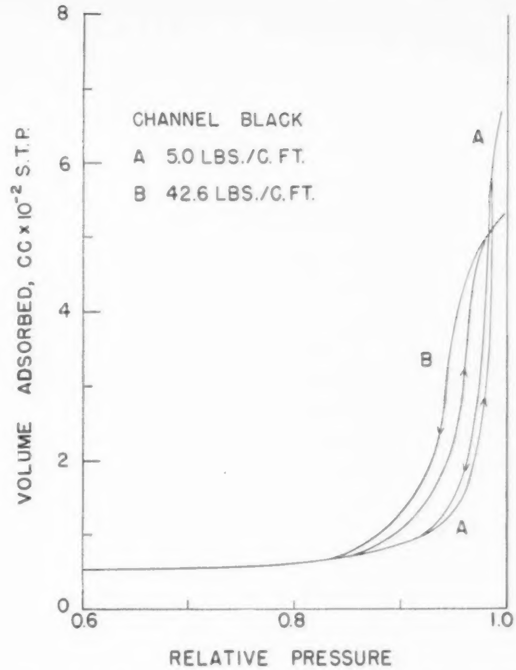

Fig. 5. Adsorption-desorption isotherms for nitrogen on uncompressed and on highly compressed channel blacks at −196° C.

The Roughness Factor

Assuming spherical particles of the same size, the relation between surface area and particle size of a pigment is a very simple one. The total surface area S is equal to

$$S = \frac{6 \times 10^4}{dD} \qquad \text{(D)}$$

where S is the surface area in square meters per gram; d the specific gravity; and D the diameter in Angstrom units.

Direct observation with the electron microscope of various pigments, such as channel and furnace types of carbon black and silica pigments, has shown that they are composed of essentially spherical particles, the diameters of which can be measured and the surface area of which can be calculated from the diameter.

A direct comparison can be made between surface areas calculated from electron microscopy and from nitrogen adsorption data, the ratio of which is known as the roughness factor f (11).

(*Continued on page 73*)

Effect of Swelling On the Properties of Elastomers[1]

By ANGUS WILSON, C. B. GRIFFIS and J. C. MONTERMOSO
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A method is described for determining the change in certain physical properties of a rubber compound immersed in liquids. The method is based on equations relating the losses in physical properties to swell in liquids. It is of particular value when test samples cannot be cut from the rubber item.

The same general equation was obtained for swell vs. property loss regardless of types of rubber, amount of cure, type of liquid that was used, or property that was tested.

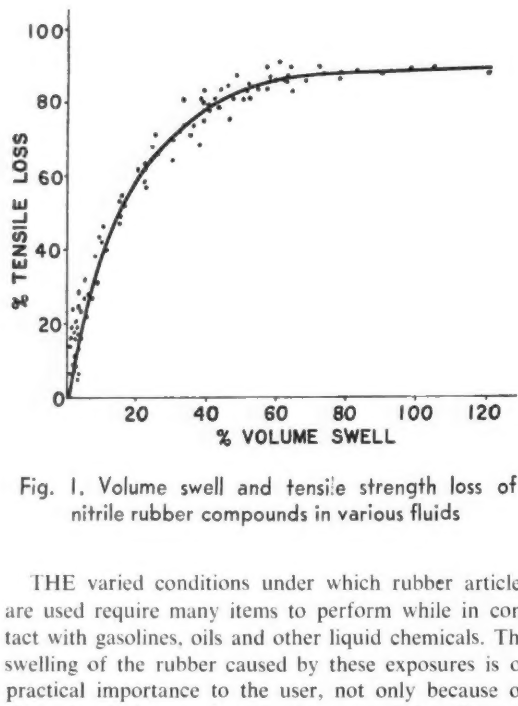

Fig. 1. Volume swell and tensile strength loss of nitrile rubber compounds in various fluids

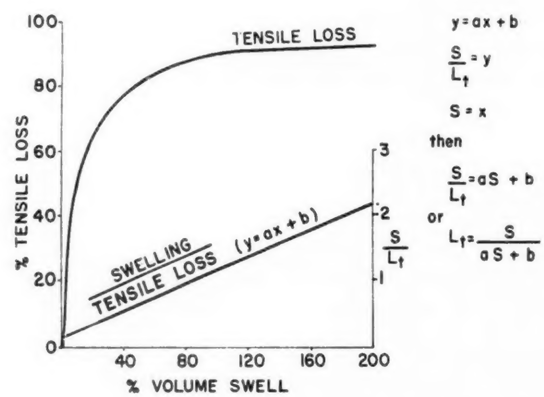

Fig. 2. Typical curves for volume swell and tensile strength loss and volume swell and ratio of volume swell to % tensile loss

THE varied conditions under which rubber articles are used require many items to perform while in contact with gasolines, oils and other liquid chemicals. The swelling of the rubber caused by these exposures is of practical importance to the user, not only because of dimensional changes, but also because of the effect on physical properties.

It would be advantageous to both the fabricator of a rubber item and its user if mathematical relationships could be established between the swell of a rubber in a liquid and the changes in its physical properties. The amounts of tensile and tear strengths, hardness and elongation remaining in a swollen rubber item are often important in determining its serviceability. Many items, such as "O" ring gaskets are too small, or are of such a shape as to prevent cutting out of standard test samples, for determining physical properties after liquid immersion. If relationships were found to exist then the losses in these physical properties could be calculated from simple volume swell measurements.

Earlier work in these laboratories (1)[2] indicated that, within the framework of the experiments conducted, a mathematical relationship did exist between swell and change in tensile strength. Figure 1 shows a graph of this relationship. It should be noted here that the scope of this work was rather restricted in that the rubbers were all acrylonitrile-butadiene types (NBR) of approximately the same state of cure, and the test fluids used were chemically similar in composition. Within this rather narrow scope it was shown that the amount of bound acrylonitrile in the rubber did not affect the volume swell-tensile loss relationship.

It would not be expected that this same relationship would be found to be applicable to other rubbers. Juve (2) has stated that equal degrees of swelling can cause unequal changes in the physical properties of different types of rubber. Hayden and Krismann (3), comparing the swelling behavior of polychloroprene with that of natural rubber, noted the different degrees of effect of swell on tensile strengths.

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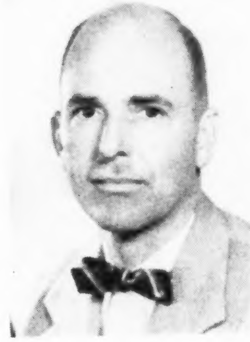
[1] Presented before the Division of Rubber Chemistry, ACS, Cincinnati, O., May 14, 1958.

[2] Numbers in parentheses refer to Bibliography items at end of this article.

Tessicini's Studio

Angus Wilson



C. B. Griffis

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Mr. Griffis has participated actively in the Army's research program on rubber during the past ten years.

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Examination of the literature shows that the phenomenon of rubber swelling in liquids has been studied by numerous investigators. Rostler and White (4) noted the relationship between swelling and the structures of the rubber and the liquid. Powers and Billmeyer (5), and Fraser (6) described the effect of time and temperature on the rate and amount of swelling. Rostler and Morrison (7), Gatton and Thompson (8), and Zapp and Guth (9), have discussed the effect of filler structure, surface area, and particle size on resistance to swelling.

Little reference was found of studies directed toward establishing practical working relationships between swelling and its effects on various rubbers. The most pertinent work was that of Gleizes (10), who plotted the relationships beween the swelling of natural rubber samples and their losses in tensile strength, hardness, and elongation. The curve she obtained for tensile loss was similar to the one for NBR previously discussed (Figure 1), but of slightly different values. Gleizes, moreover, found that plotting % volume swell against the ratios of % volume swell to % tensile loss and % volume swell to % elongation loss gave essentially straight lines. She stated that these lines fitted the general equation, $y=ax+b$, i.e., the equation for a straight line intersecting the y axis, where a is the constant for the slope of the line, and b is the value of intersection of the y axis.

Typical plots of % volume swell *versus* % tensile loss and % volume swell *versus* the ratio of % volume swell to % tensile loss are shown in Figure 2. By % volume swell is meant 100 times the ratio of the increase in volume to the original volume, and likewise % loss is equal to 100 times the ratio of the decrease in the value of a particular property to the original.

Consider the ratio plot in Figure 2 first; if we take the equation $y=ax+b$ and substitute for y the ratio of

% volume swell (S) to % tensile loss (Lt), or $\frac{S}{Lt}$;

and for x % volume swell (S), then:

$$\frac{S}{L_t} = aS+b$$

or:

$$L_t = \frac{S}{aS+b}$$

This last expression gives us an equation for the curve relating tensile loss to volume swell, and this procedure gives us a means of establishing mathematical relationships between volume swell and losses in physical properties. This holds, provided, of course, that the relationships are of the same general type and follow the equation $L = \frac{S}{aS+b}$. The values of S and L can be determined experimentally, and those of a and b can be found from the slope and intersection, respectively, of the ratio plot.

Experimental Work

Four variables were evaluated for their effects on the relationships between the swelling of rubber specimens and the changes in their properties. They were: type of rubber, amount of cure, type of swelling liquid, and property tested.

Test stocks were made from 60/40 butadiene/acrylonitrile rubber (NBR), butadiene styrene rubber (SBR 1502), smoked sheet natural rubber, polychloroprene and polysulfide rubbers. Stocks of the first three types were made with cures varying from soft to semi-ebonite. Amounts of sulfur varied from 1-2 parts to 15-18 parts, with corresponding increases in amounts of accelerators used in these compounds. Amounts of other ingredients were kept constant in the compounds, except for those used for the high sulfur cure of natural rubber. This latter compound contained a small amount of plasticizer to improve molding properties. The polychloroprene and polysulfide rubbers, incapable of being made into hard rubber, were made in only one recipe each. All stocks were cured to optimum tensile. The recipes used are given in Table 1, and the original physical properties are given in Table 2.

Fourteen swelling liquids were used for evaluating the effect of liquid composition on the compounds and as a means of controlling the amount of swelling. They were of three basic types. The first series consisted of standard test mediums, of Federal Test Method Standard No. 601,[3] Nos. 4, 5, and 6. No. 4 is 100% iso-octane; No. 5 is 60% iso-octane, 5% benzene, 20% toluene and 15% xylene. No. 6 is 70% iso-octane and 30% toluene. The second set was mixtures of methanol and benzene, beginning with 0% benzene and increasing by 20% increments to 100% benzene. The third set of liquids was mixtures of methanol and methyl isobutyl ketone in the same ratios as the methanol/benzene mixtures. All percentages are by volume.

In order to have a standard basis of comparision all tests on swollen samples were run after they had reached swelling equilibrium. Equilibrium, in this study, was defined as the state where change from one day to another is negligible, even though slight increases in volume may be noted.

Sufficient tensile sheets of each stock were molded at one time to permit a complete series of tests. Using Die C of ASTM[4] Designation D 412-51T, 75 tensile specimens were cut out. Five of these were used for determination of original tensile strength, elongation, and hardness. Five were also placed in each of the swelling liquids together with two- by one-inch volume swell samples and held at 75 ± 1° F. until all had reached swelling equilibrium. At the end of this time the increase in volume of the swell samples was determined, using the water displacement method. The tensile specimens were removed singly, blotted dry, and

Fig. 3. Swelling test equipment for rubber samples

tested immediately for ultimate elongation and tensile strength, using an Instron[5] strain gage-type machine with a jaw separation speed of 20 inches per minute. Tear specimens cut out with a die conforming to the dimensions of Die B of ASTM Designation D 624-54 were tested under the same conditions.

Tensile strengths were calculated on the basis of the cross-sectional area of the test specimen before swelling. Tear strengths were calculated, using the original thickness of the specimens, and specimens were nicked before swelling. Hardness measurements were made on single swollen tensile specimens placed on three plied up unswollen tensile specimens of the same stock. Readings were taken five seconds after application of load.

Swelling procedures were carried out, using glass stoppered No. 10 museum jars, containing 500 milliliters of test fluid. Open-end cylinders of stainless-steel screening were placed into the jars. The five tensile or tear specimens were placed standing between the stainless-steel cylinder and the inside wall of the jar. The two volume swell samples were suspended on a wire across

[3] General Services Administration, Washington, D. C.
[4] American Society for Testing Materials, Philadelphia, Pa.
[5] Instron Engineering Corp., Quincy, Mass.

TABLE 1. COMPOUNDING RECIPES

	20A1	20A2	20A5	20S7	20S8	20S9	20R1	20R2	20R3	20R9	20M1	20P1
60/40 NBR	100	100	100									
SBR 1502				100	100	100						
Smoked sheet							100	100	100	100		
Neoprene WRT											100	
Thiokol ST												100
Reogen[a]										1		
MPC black				40	40	40						
EPC black	40	40	40				40	40	40	40		
SRF black											30	
HAF black												40
XLC magnesia											5	
Methyl Tuads[b]				0.15	0.2	0.4	0.15	0.20	0.5	2		
Altax[c]	1.5	2.7	2.85	1.5	2.5	3	1	2.25	3.5			
Captax[d]										2		
Vandex[e]										2		
Permalux[f]											0.75	
Stearic acid	1	1	1	2	2	2	1	2	2			0.5
Zinc oxide	5	5	5	5	5	5	5	5	5	2	2	5
Neozone A[g]	1	1	1									
Neozone D[h]											1	
AgeRite White[i]				1	1	1	1	1	1	0.5		
Sulfur	1.2	10	15	2	10	18	2	10	18	18		1
GMF												1.5
Cure time (min.) & temp. (°F.)	50/287	20/300	35/310	30/300	45/300	30/320	10/300	35/320	35/320	45/320	15/307	30/287

[a]Mixture of high molecular weight sulfonic acid and paraffin oil, R. T. Vanderbilt Co., New York, N. Y.
[b]Tetramethyl thiuram disulfide, Vanderbilt.
[c]Benzothiazyl disulfide, Vanderbilt.
[d]2-Mercaptobenzothiazole, Vanderbilt.
[e]Selenium, Vanderbilt.
[f]Di-ortho-tolylguanidine salt of dicatechol borate, Vanderbilt.
[g]Phenyl-alpha-naphthylamine, E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department, Wilmington, Del.
[h]Phenyl-beta-naphthylamine, Du Pont.
[i]Beta-naphthyl-para-phenylenediamine, Vanderbilt.

TABLE 2. ORIGINAL PHYSICAL PROPERTIES AND COMPOUNDS USED

QM Code No.	20A1	20A2	20A5	20S7	20S8	20S9	20R1	20R2	20R9	20M1	20P1
Type of rubber	60/40 NBR	60/40 NBR	60/40 NBR	SBR 1502	SBR 1502	SBR 1502	nat. rub.	nat. rub.	nat. rub.	neo-prene	Thiokol ST
Type of cure	low	medium	high	low	medium	high	low	medium	high	*	*
Tensile, psi.	3800	3000	3600	3600	2200	3000	2750	1850	1900	2900	1400
Tear, pi.	255	165	250	205	130	300	700	195	270	295	280
Ult. elong., %	600	220	110	530	120	95	540	320	120	535	470
Stress @ 300% psi.	1250	—	—	1350	—	—	1000	1625	—	1550	950
Hard. Shore A, 5 sec.	60	74	82	65	84	97	43	69	92	52	61

*These rubbers, incapable of being compounded into hard rubber, were made in a single recipe.

TABLE 3. CONSTANTS FOR EQUATION $L = \frac{S}{aS + b}$ RELATING LOSS IN PHYSICAL PROPERTIES OF COMPOUNDS TO SWELL IN LIQUIDS

QM Code	Tensile		Tear		Elongation		Hardness	
No.	a	b	a	b	a	b	a	b
20A1	0.0101	0.13	0.0095	0.17	0.0105	0.24	0.0183	0.36
20A2	0.0107	0.08	0.0092	0.21	0.0119	0.18	0.0296	0.94
20A5	0.0115	0.05	0.0094	0.09	0.0126	0.16	0.0730	1.18
20S7	0.0106	0.07	0.0100	0.16	0.0112	0.18	0.0192	0.68
20S8	0.0121	0.13	0.0103	0.09	0.0093	0.47	0.0546	1.19
20S9	0.0103	0.08	0.0098	0.03	0.0096	0.13	0.0584	0.40
20R1	0.0097	0.37	0.0088	0.35	0.0084	0.96	0.0224	0.47
20R2	0.0119	0.13	0.0099	0.14	0.0107	0.28	0.0306	0.39
20R9	0.0110	0.11	0.0101	0.05	0.0088	0.34	0.0289	0.16
20M1	0.0131	0.43	0.0103	0.13	0.0112	0.70	0.0234	0.95
20P1	0.0105	0.23	0.0088	0.19	0.0108	0.19	0.0185	0.83

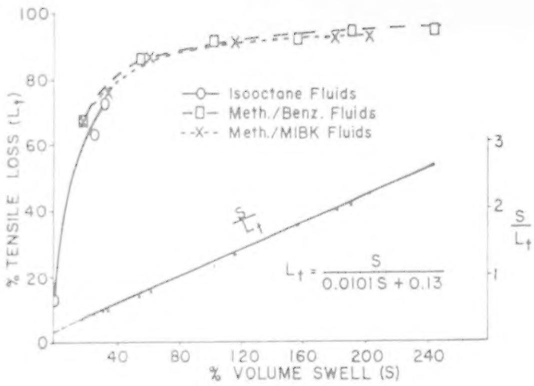

Fig. 4. Volume swell and tensile strength loss *(upper curve)* and volume swell and ratio of volume swell and tensile strength loss, S/L_t *(lower curve)*, for low-sulphur NBR compound in various liquids

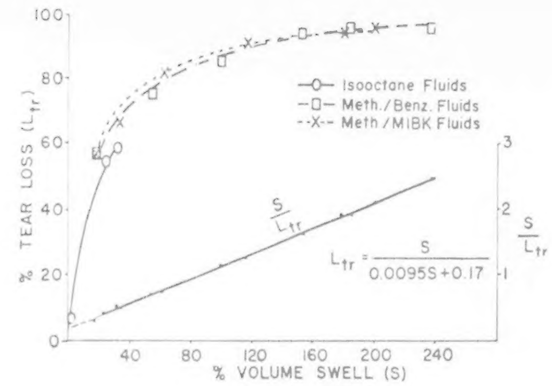

Fig. 5. Volume swell and tear strength loss *(upper curve)* and volume swell and ratio, S/L_{tr} *(lower curve)*, for low-sulphur NBR compound in liquids

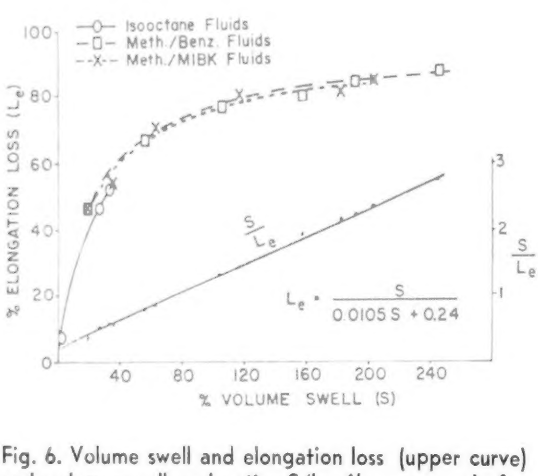

Fig. 6. Volume swell and elongation loss (upper curve) and volume swell and ratio, S/L_e *(lower curve)*, for low-sulphur NBR compound in various liquids

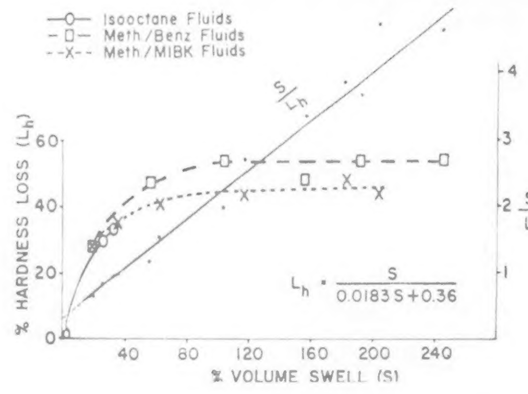

Fig. 7. Volume swell and hardness loss *(dotted curves)* and volume swell and ratio, S/L_h *(straight line)*, for low-sulphur NBR compound in various liquids

the cylinder; so they hung within the cylinder. The jars were then immersed in a constant temperature bath. The equipment is pictured in Figure 3.

Average % swell and average % loss in the values of the properties were plotted on graphs. A separate graph was plotted for each rubber stock and each property tested. This gave curves showing the relationship of swell to property loss. Also plotted were the ratios of % swell to % property loss. From the slope and intercept of these latter plots the values of *a* and *b* in the equation $L = \frac{S}{aS + b}$ were obtained for each property and each stock.

Results and Discussion

The same general type of curve, of the form $L = \frac{aS + b}{S}$, was obtained for swell *vs.* property loss, regardless of types of rubber, amount of cure, type of liquid used, or property tested. The curves all show an initial rapid loss of the property tested with low swelling. The rate of loss then gradually decreases until practically a straight line is reached. Plots of ratios of % swell to property loss against swell gave essentially straight lines in all cases. Examples of these are the graphs of the relationships and the ratio plots for the low acrylonitrile rubber (NBR) stock, shown in Figures 4 through 7.

Although the equations obtained were all of the same type, they differed for each rubber stock run—that is, the values of *a* and *b* in the equation were constant for specific rubber compounds, but in general varied between types of rubber and different cures of the same rubber. Type of liquid used had little effect. The values of *a* and *b* for each stock tested are listed in Table 3. The volume swell-tensile loss and volume swell-elongation loss relationships for the nitrile rubbers were less affected by differences in cure than were any of the other relationships. Within the limits of this work the equations for tensile and elongation losses of the low sulfur cure of NBR could also be used as good approximation for the medium and high sulfur cures of the NBR.

Summary and Conclusions

The method outlined in this paper gives a convenient means of establishing mathematical relationships between the volume swells and property losses of rubber stocks. Once the constants a and b have been determined, the equation $L = \frac{S}{aS + b}$ can be used to determine losses in physical properties from simple volume swell measurements on samples cut from end-items.

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Pore Sizes and Distribution

(Continued from page 67)

A number of investigators have studied the roughness factors of reinforcing pigments. It appears (1) that this factor is very close to unity for EPC channel blacks and for a number of furnace blacks. This indicates beyond any doubt that the particles of the blacks are smooth, spherical particles without any pores. For oxidized channel blacks and for some conductive furnace blacks, the roughness factor, however, is larger than unity and may be even as high as 3 or 4, indicating a marked porosity (Table 1).

Similar effects have been observed with silica and other materials used as reinforcing pigments.

Investigations have indicated that nearly all of the pigments with a roughness factor larger than unity fail to show any desorption hysteresis at relative pressures below 0.80. Consequently, the porosity of the pigments must be caused by Class I capillaries of diameters below 40 Å.

TABLE 1. ROUGHNESS FACTORS OF VARIOUS CARBON BLACKS

Carbon Black	Mfr.	Type	Roughness Factor, f
Channel	Huber	EPC	1.0
Channel	Huber	MPC	1.1
Channel	Huber	HPC	1.3
Monarch 74	Cabot	CC	2.5
Carbolac 1	Cabot	CC	3.8
Vulcan SC	Cabot	CF	1.8
Aromex HAF	Huber	HAF	1.0
Essex	Huber	SRF	1.0

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(To be continued)

Non-Uniform Cellular Material

Causes of non-uniformity of density of closed-cell sheets of cellular rubbers and plastics are reviewed in a recent issue of Rubatex Products, Inc., Newsletter by R. J. Noble, vice president for research and development of that company. In the searching for causes of such non-conformity it is suggested that the condition of all press platens be checked, especially the exterior condition of the platens.

If a press platen is heated unevenly, owing to clogging, series feed, poor trapping, or other cause, or if it is bent, the sheet produced on that platen may show considerable difference in expansion and hardness from one side to the other. It may also have a density notably different from that of other sheets from the same press.

Mold pressures for expanded shoe-sole slabs will approximate 1,000 psi. of cavity; for automotive sheets the pressure may be 2,000 psi.; and for expanded plastics, about 3,500 psi. The platens used in each must be sufficiently heavy and rigid to withstand these pressures; if the platens bend, molds cannot be tightly closed, and several production difficulties arise.

Under these conditions an excessive amount of flash will be obtained. As the blowing agent decomposes, compound is extruded at the opening, and although a sheet of normal size may be obtained, its weight and density will be less than normal. Furthermore, the edge of the sheet at which extrusion occurs will have a structure which is predominantly open-cell, and will be softer than the remainder of the sheet.

In extreme cases the platen may be so bent that the mold does not close on two or more edges. This condition permits a relatively free expansion of the rubber, as in the manufacture of sponge. The complete sheet may then have a generally open-cell structure and will be wholly unsuited for any application for which a closed-cell material is indicated, Dr. Noble emphasized.

The Dispersion of Carbon Black in Rubber And Its Role in Vulcanizate Properties—II*

By C. W. SWEITZER, W. M. HESS and J. E. CALLAN
Columbian Carbon Co., New York, N. Y.

THE following installment concludes the informative article on the dispersion of carbon black in rubber and its role in vulcanizate properties, which was begun in our September issue.

Role of Dispersion in Vulcanizate Properties

With methods available for evaluating the state of dispersion in rubber compounds, and with some knowledge of the factors influencing the state of dispersion, it is possible to assess with some degree of certainty the role of dispersion in the development of vulcanizate properties.

Particle Size and MB Loading of Carbon Black

In Figures 4A-D,[8] inclusive, it was demonstrated that little difficulty with dispersion is encountered with a coarse black of the SRF type, whereas a fine reinforcing black of the SAF type does involve dispersion problems. In further investigation of this particle size effect a range of rubber carbons was employed, varying in fineness from SRF to SAF. Compounds containing 50 phr. LTP SBR were prepared for all the carbons from 25-, 50-, and 75-part masterbatch (MB) mixes; these MB loadings were selected to provide a range of dispersion states with the Banbury mixing procedure otherwise constant.

The relation from this study among fineness, dispersion, and tensile strength is shown in Figure 7. The dispersion rating by the photographic method remains high for the coarser carbons at all carbon black content MB loadings; whereas with the finer carbons, dispersion improves markedly with high carbon content MB loading. Tensile strength shows a slight increase with MB loading for the coarser carbons, but a more pronounced increase with MB loading for the finer carbons. This tensile increase is ascribed to improved dispersion of the carbon black, the improvement measurable photographically for the finer carbons, but requiring a higher order of resolution for the coarser carbons.

75 Parts Carbon MB Loading

The results with stocks prepared from 75 parts carbon black MB mixes were so striking in terms of dispersion and tensile strength that additional studies were carried out to determine the effect of this procedure on tire wear. Laboratory mixed recap stocks of 50

* Presented before the Division of Rubber Chemistry, Chemical Institute of Canada, Toronto, Ont., May 28, 1958.
[8] See our Sept., 1958, issue, p. 875.

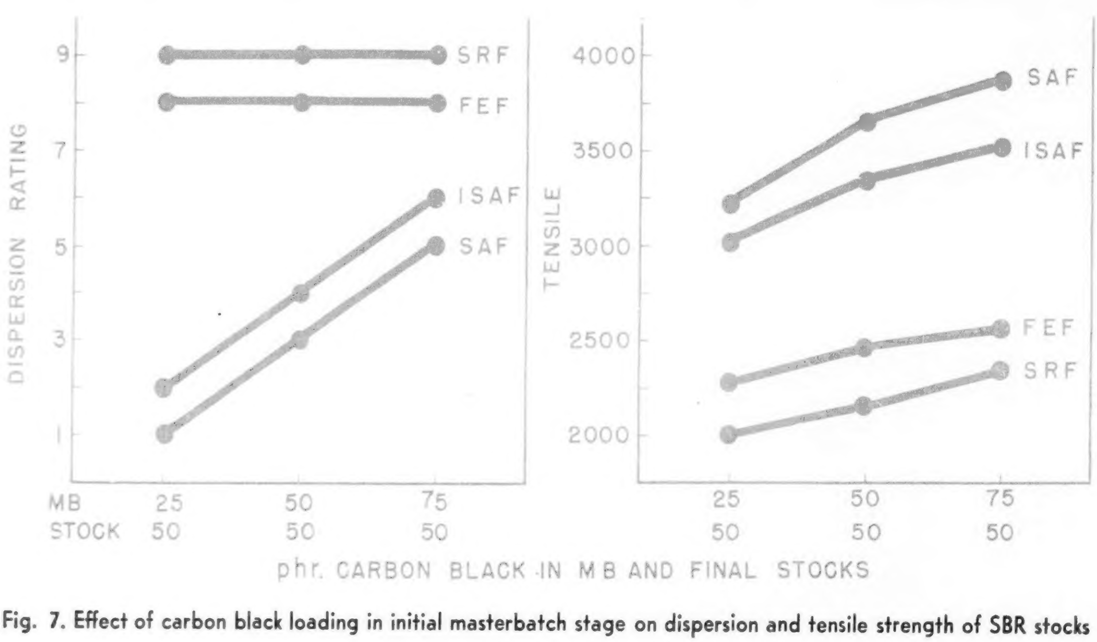


Fig. 7. Effect of carbon black loading in initial masterbatch stage on dispersion and tensile strength of SBR stocks

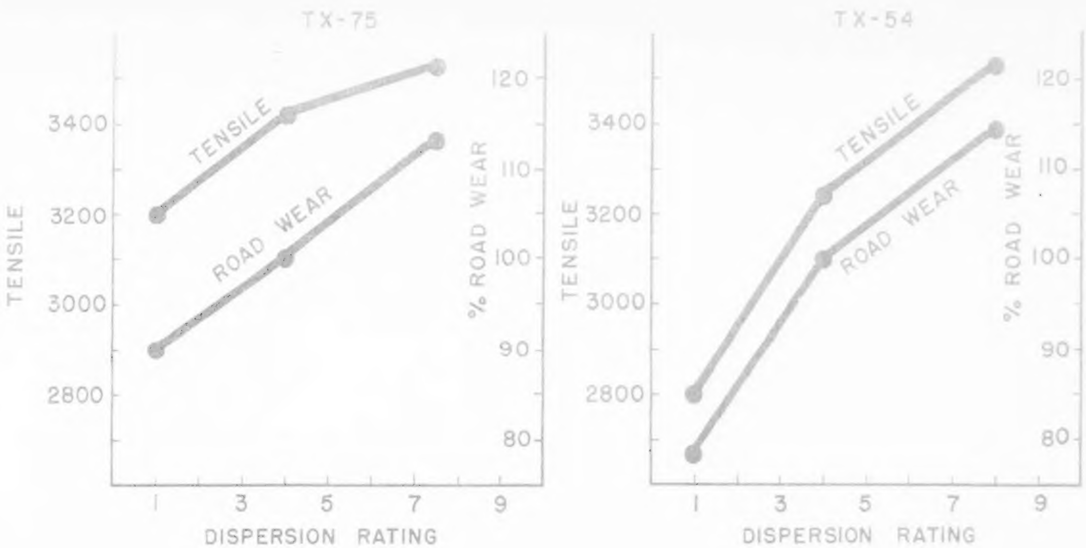


Fig. 8. Effect of carbon black dispersion rating on tensile strength and road wear of tires for dry mixed 50 phr. ISAF in SBR stock

Table 1. Effect of Masterbatch Loading (Dry Mixing)

50 Phr. ISAF in SBR

Properties	50-Part MB	75-Part MB
Modulus (L-300), psi.	1610	1720
Tensile, psi.	3320	3560
Elongation, %	520	560
Hardness, Shore A	58	57
Log R, ohms/cm.[3]	3.8	5.0
Rebound, %	53.7	54.7
Dispersion (photo)	4.5	8
Road wear	100	113

Table 2. Effect of Banbury Mixing Procedure

50 Phr. ISAF in SBR

Properties	Oil Added First 50 MB	Oil Added Last 50 MB	Oil Added Last 75 MB
Modulus (L-300), psi.	980	1050	1100
Tensile, psi.	3000	3320	3560
Elongation, %	610	625	590
Rebound, %	50.6	51.0	52.5
Log R, ohms/cm.[3]	3.2	3.3	3.6
Dispersion (photo)	1	4	8

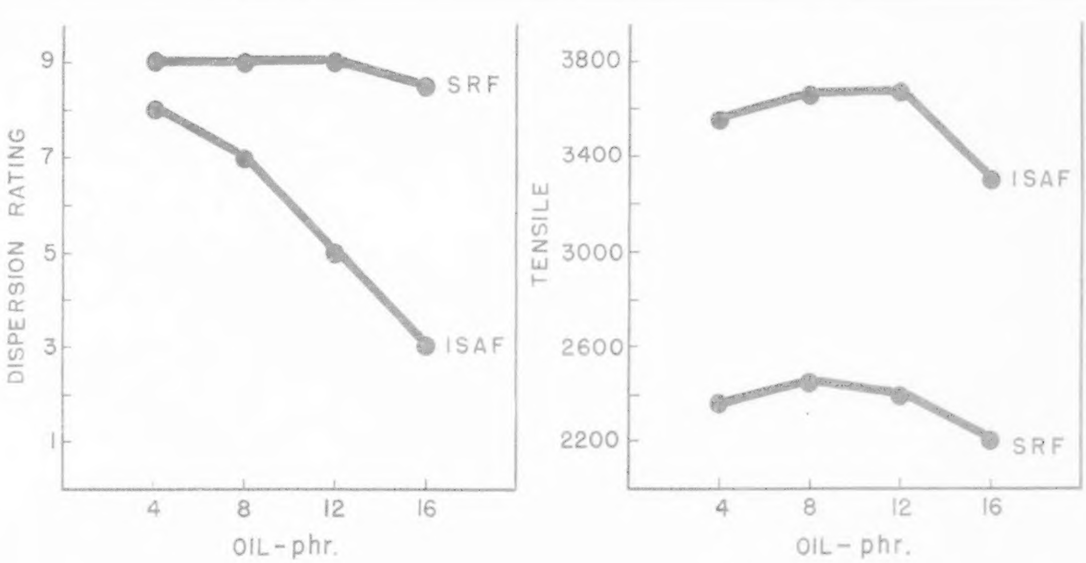


Fig. 9. Effect of oil content on dispersion rating and tensile strength of LTP SBR stocks containing 50 phr. of ISAF and SRF blacks

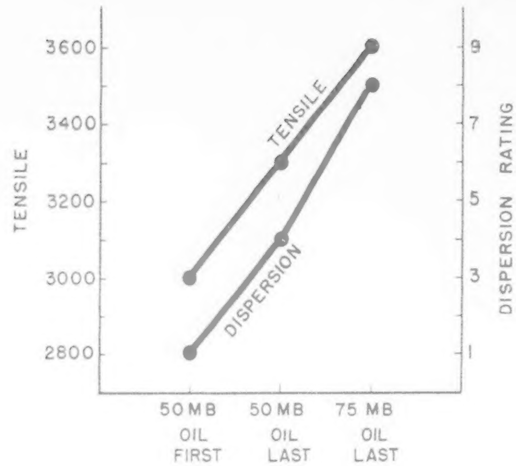


Fig. 10. Effect of mixing procedure on dispersion rating and tensile strength of SBR stock containing 50 phr. ISAF

parts ISAF in LTP SBR were prepared from 50- and 75-part carbon black MB mixes. A poor dispersion was also included in the program, prepared poor deliberately by a drastic shortening of the mixing cycle in the (50-part) masterbatch stage.

The results for two such programs in terms of photographic dispersion rating, tensile, and road wear are presented in Figure 8, with additional physical data for one of the programs in Table 1. In both studies the use of 75-part MB mixing in the initial stage greatly improved dispersion, with consequent striking increases in tensile and tire wear; this increase in tire wear amounted to as much as 15% over normally mixed stocks and 35% over poorly mixed stocks. Associated with these tensile and wear increases is a measurable increase in log R[9] and rebound.

Oil Dosage

The effect of increasing the oil dosage in 50 phr. stocks of LTP SBR is demonstrated in Figure 9. The photographic dispersion rating of the ISAF stocks decreases rapidly with increasing oil content, with the SRF stocks, however, developing a drop in dispersion rating only with the highest oil dosage.

In tensile properties the results are somewhat surprising, with optimum values at intermediate oil levels; the decreases occur only with the higher oil content. These tensile differences for the lower oil loadings, possibly due to variations in testing, are being checked by further tests.

The decrease in dispersion is unquestionably associated with the decreased viscosity of the stock due to the addition of oil; this depressing effect is most pronounced for the finer ISAF black, indicating the need of higher viscosity mixing with the finer blacks to secure a dispersion level approaching that given by coarser blacks.

[9] Log R is the log of electrical resistivity of a rubber compound in ohms/cm.^{3} Increases in log R in this instance are indicative of increased dispersion.

TABLE 3. EFFECT OF MASTERBATCH TEMPERATURE

	50 Phr. ISAF in SBR	
Properties	Cool Mix (330° F.)	Hot Mix (415° F.)
Modulus, psi.	1740	2650
Tensile, psi.	3680	3530
Elongation, %	485	365
Hardness, Shore A	55	57
Log R, ohms/cm.^{3}	6.0	7.3
Rebound, %	58.4	59.9
% Carbon gel	44	68
Dispersion (photo)	6	6
(E. M.)	particulate	aggregative
Road wear	100	106
Cracking resistance	good	poor

Banbury Mixing Procedure

The order of carbon black and oil addition also has a pronounced effect on dispersion and physicals, as revealed by the results in Table 2 and Figure 10.

The addition of oil with the first half of the carbon black leads to depressed dispersion and physicals; whereas the addition of oil after all the carbon black has been incorporated enhances dispersion and physicals. Using a 75-part carbon MB mix instead of a 50-part carbon MB mix with late oil addition further enhances dispersion and physicals.

Associated with this improved dispersion and tensile is a modest increase in modulus, rebound, and log R. The greater increase in rebound and log R for the stock prepared from the 75-part carbon MB is ascribed to the additional rubber added during the second mixing stage.

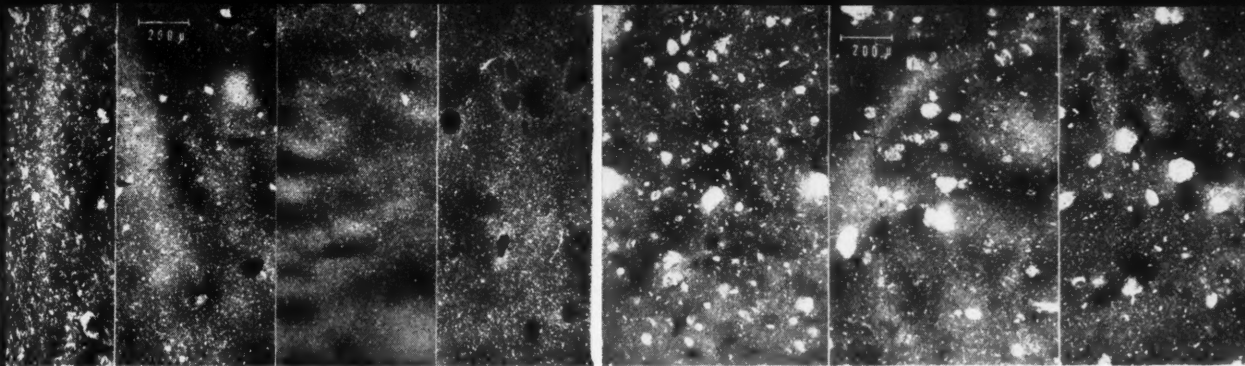
Remilling

Remilling will produce variable dispersion effects, depending to a large extent on the polymer. The remilling of natural rubber stocks in the Banbury definitely improved the dispersion of ISAF black, as shown by the X-ray photographs of unvulcanized stocks in Figure 11 (*left*). The most significant change resulted from the first remilling. Improved tensile properties were associated with this better dispersion.

In LTP SBR stocks, on the other hand, remilling did not improve the dispersion of ISAF black [Figure 11 (*right*)], the agglomerates in the MB stage persisting into the final mixing stage as well as into the vulcanizate. The significance in these preliminary remilling studies lies more in the practical use made of the X-ray method for assessing state of dispersion in unvulcanized stocks than in the few results reported on dispersion.

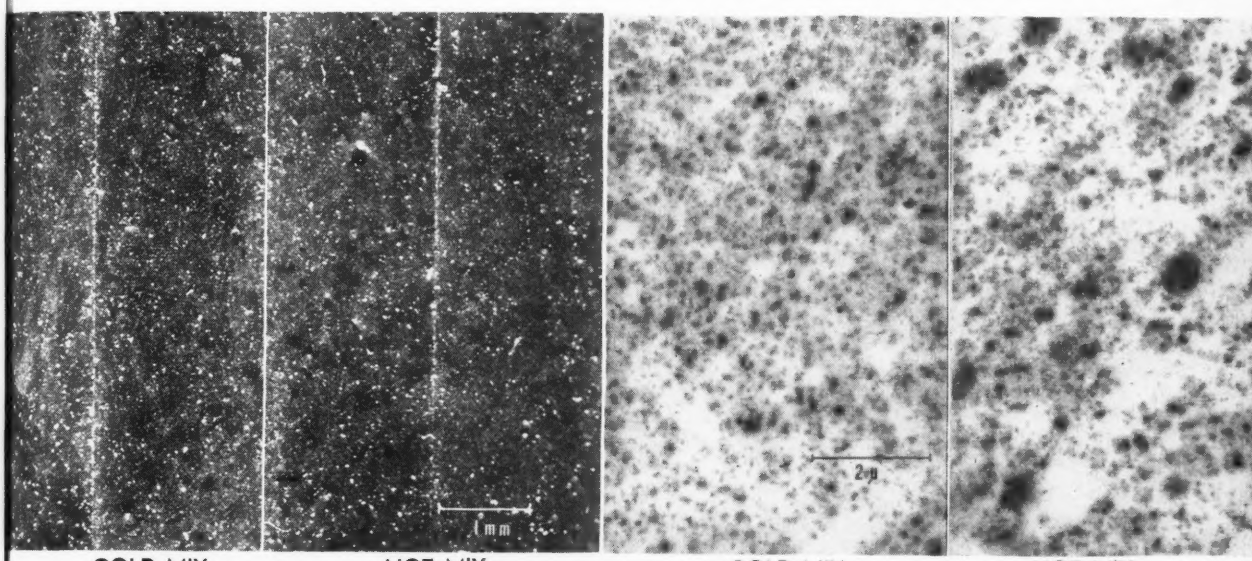
Masterbatch Temperature

The role of masterbatch temperature was reexamined with particular attention to its effect on state of dispersion. In one study with 50 parts ISAF black in LTP SBR the two mixing temperatures employed were 330 and 415° F., respectively. The dispersion and physical



MB | 1st REMILL | 2nd REMILL | FINAL STAGE | MB | TWO REMILLS | FINAL STAGE

Fig. 11. Effect of remilling 50 phr. of ISAF in natural rubber (*left*) and in SBR (*right*). Dispersion examined by X-ray method

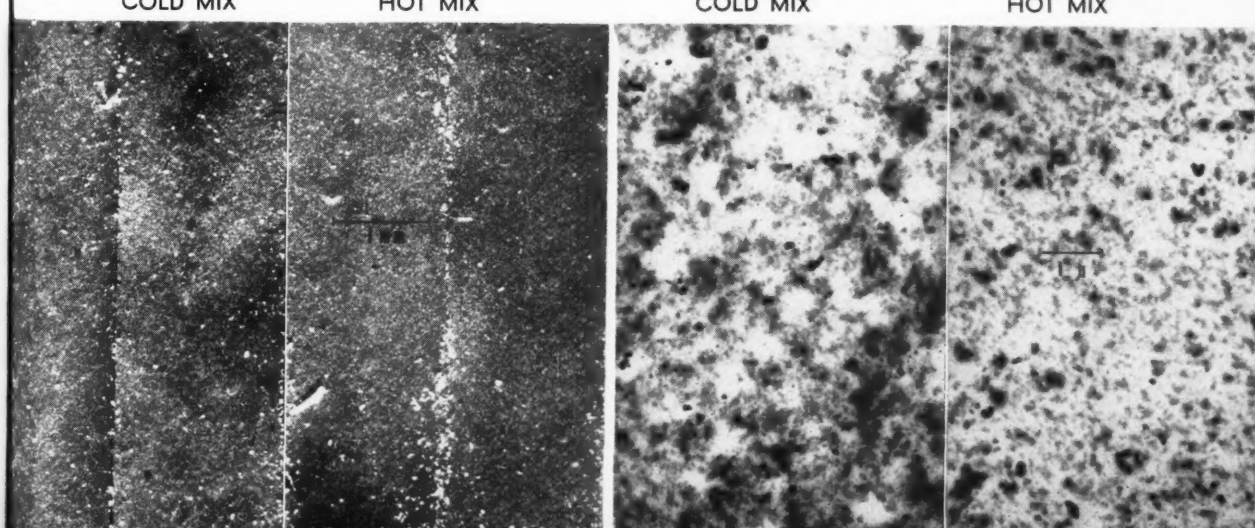


COLD MIX | HOT MIX | COLD MIX | HOT MIX

Fig. 12. Effect of mixing temperature on dispersion of 50 phr. of ISAF black in SBR, as examined by photographic method (*left*) and electron microscope method (*right*)

Fig. 13. Effect of mixing temperature on dispersion of 50 phr. of HAF black in butyl rubber, as examined by photographic method (*left*) and electron microscope method (*right*)

COLD MIX | HOT MIX | COLD MIX | HOT MIX



Properties	Cool Mix	Hot Mix
Modulus, psi.	1900	2675
Tensile, psi.	2555	3110
Elongation, %	405	355
Hardness, Shore A	61	48
Log R, ohms/cm.[3]	7.8	10.9
Dynamic modulus	10.4	7.9
% Relative damping	36.5	20.8
Dispersion (photo)	8	8
(E. M.)	micro aggregates	particulate

TABLE 4. EFFECT OF MASTERBATCH TECHNIQUE

50 Phr. HAF in Butyl Rubber

Reference: Esso data—private communication.

property results for these two compounds are presented in Table 3. The physical property changes resulting from hot mixing are of the same order as reported in earlier studies. Modulus shows a large increase: tensile is depressed modestly; elongation is down; hardness is up, and log R and rebound are higher. Carbon gel is about 50% greater. Road wear is increased by 6%; while cracking resistance[10] is poorer. It is concluded that the enhanced modulus developed by the high mixing temperature dominates the pattern of properties.

In examination of torn surfaces of these stocks no measurable differences in dispersion were shown by the photographic method [Figure 12 *(left)*]. At the electron microscope level, however, significant differences were evident [Figure 12 *(right)*]. The uniform pattern of dispersion for the cold mixed stock has been altered to a non-uniform flocculated pattern for the hot mixed stock, associated with an increase in the carbon gel level and possibly the polymer gel level as well, the result of excessive polymer cross-linking. This pattern is typical for SBR stocks mixed at high temperatures.

In a second study 50-part HAF butyl tread compounds, prepared by the cold and hot mixing techniques described by Esso Laboratories, were tested for dispersion and property differences. The results are set forth in Table 4. A striking increase in modulus as well as in tensile strength is shown for the hot mixed compound. Elongation is down, but hardness is significantly lower. The decrease in dynamic modulus and damping indicates less heat buildup or improved hysteresis.

Examination of these stocks for dispersion differences by the photographic method revealed, as in the case of the SBR study, no measurable difference between the cold and hot mixes [Figure 13 *(left)*]. At the electron microscope level, however, significant differences were shown [Figure 13 *(right)*]; the pattern, in fact, reversed that developed in the SBR study. With the cold mix, dispersion had only reached a non-uniform micro aggregate stage; whereas in the hot mix dispersion had developed to a more uniform and particulate state.

This difference in behavior under excess heat conditions for the two polymers probably is associated with their cross-linking properties: SBR emphasizing polymer-polymer cross-linking with possible polymer gel development; butyl rubber emphasizing polymer-carbon cross-linking with negligible polymer gel development. This improved dispersion at the ultimate level for the hot mixed stock is undoubtedly responsible for the increased tensile strength, since tensile has been shown throughout this paper to be particularly responsive to dispersion. The higher modulus is associated with enhanced carbon gel development, at a particulate rather than an aggregative level, as in the case of SBR.

Wet Masterbatching (Black Rubber)

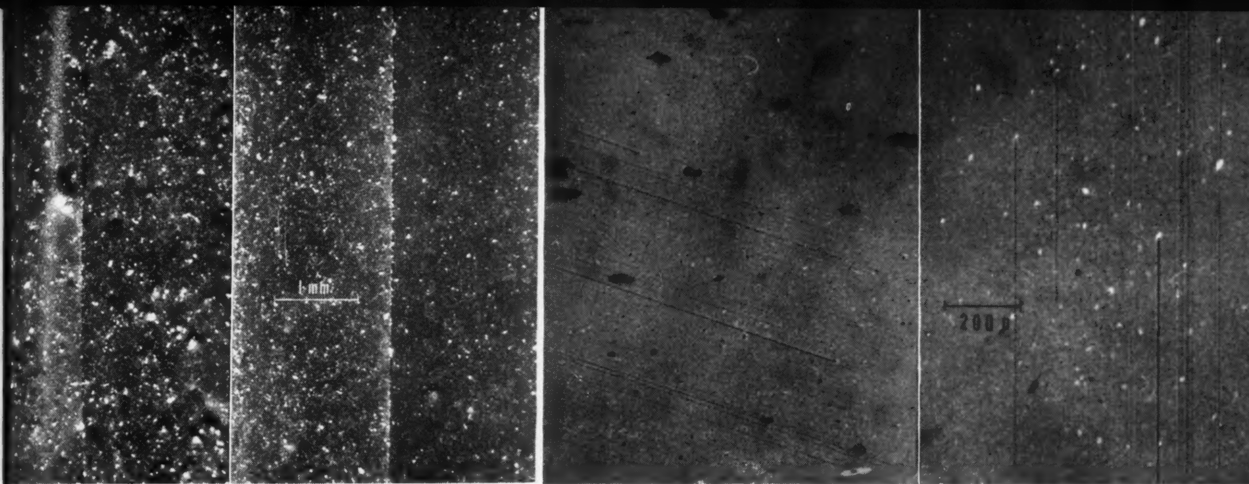
One well-recognized method for securing improved dispersion of carbon blacks, particularly of the finer tread carbons, is by premixing carbon black and rubber latex prior to coagulation, the wet masterbatching or black rubber process. Two general approaches have been developed. The original approach involved the preparation of an aqueous carbon black dispersion through the aid of dispersing agents, the mixing of this dispersion with the latex, followed by coagulation to a black crumb baled and shipped to the compounders for the finishing mixing steps on standard mixing equipment. Dispersion of the carbon black in the final stocks

[10] Cracking resistance is expressed in terms of total linear inches of cracks in the tread grooves on completion of tire tests, usually after 16,000 miles. The fewer the cracks, the better the cracking resistance.

TABLE 5. DRY MIXING *vs.* WET MASTERBATCHING (BLACK RUBBER)

50 Phr. Tread Carbons in OEP — Laboratory Mixing

	HAF		ISAF		SAF	
Properties	Dry	Wet	Dry	Wet	Dry	Wet
Modulus (L-300), psi.	1480	1500	1500	1500	1400	1280
Tensile, psi.	2750	3200	3000	3500	3330	3850
Elongation, %	485	575	490	565	555	620
Hardness, Shore A	57	57	60	60	58	60
Log R	4.1	4.1	3.3	3.3	2.3	2.3
Rebound	53.7	53.7	49.0	49.0	44.7	44.0
Mooney Viscosity	57	55	59	56	63	60
Dispersion (photo)	6	7	5	9	4	8



DRY MIX BLACK MASTER MIX DRY MIX BLACK MASTER MIX

Fig. 14. Effect of dry mixing *vs.* Columbian process wet masterbatching on dispersion of 50 phr. of SAF black in oil-extended SBR, as examined by the photographic method (*left*) and light microscope method (*right*)

was somewhat improved, but property improvements did not follow; this result was ascribed generally to the depressing effect of the dispersing agents.

In the most recent and widely publicized approach developed by Columbian Carbon Co. (19)[11] the process has been made continuous with the elimination of the dispersing agents. Violent agitation is employed to disperse and to hold in suspension the carbon black in a water slurry, which is continuously mixed with the latex in proper proportions, and then coagulated with the salting step eliminated to the black crumb stage. This product does show enhanced physical and performance properties when mixed and compounded into final vulcanizates.

Numerous investigations on these black rubber stocks have been carried out in our laboratories, with the results for typical laboratory preparations presented in Table 5. The data show typical property changes resulting from the Columbian black rubber process with 50 phr. tread carbons in SBR (OEP type) polymer.

Modulus and hardness are relatively unchanged, while tensile and elongation are markedly increased with the wet as compared with the dry mixing process, a pattern of property changes directly opposite to that shown by the use of high MB mixing temperature. Log R and rebound are relatively unchanged, while viscosity is slightly decreased. The dispersion improvement becomes progressively more pronounced with the finer blacks, suggesting that this process will open the way to the more effective use of finer tread carbons.

The black rubber Columbian wet (MB) stocks are slightly faster curing. The significant result, it would appear, is the startling increase in tensile strength, ascribed to a large extent to the improved dispersion of the carbon black [Figure 14 (*left and right*)]. Other factors associated with the intimate premixing of carbon and polymer prior to mastication may also be contributory.

The results of a second study on factory mixed stocks, with 50 parts ISAF carbon black in LTP SBR, are presented in Table 6 and Figure 15.

[11] See our Sept. 1958, issue, p. 876.
[12] Metals Disintegrating Co., Mikro-Pulverizer Division, Summit, N. J.

The different heat history of factory-mixed stocks, involving higher temperature and longer retention of heat, will account in all probability for any differences noted in physical properties from the preceding study. In the case of factory-mixed stocks there is a modest increase in modulus associated with a striking increase in tensile; this variation from the laboratory mixed stocks accounts for the smaller increase in elongation. The increase in scorch is indicative of a slightly faster rate of cure for the black rubber compounds. The 10% increase in tire wear together with an improved resistance to cracking is a typical benefit resulting from the use of Columbian process black rubber compounds.

Improved dispersion of the carbon black again appears to be the major factor in the tensile and wear improvements, with the slight increase in modulus tending, it is believed, to depress somewhat the cracking resistance potential. The suggestion is offered that insofar as possible the heat history of these black rubber stocks be controlled during Banbury mixing.

Dry Premixing Prior To Masterbatching

Since dispersion does play such a significant role in tensile development, with premixing as represented by wet masterbatching a most important approach to improved dispersion, it would seem logical to check the effect of dry premixing of carbon black and rubber prior to mastication in the Banbury. This dry premixing is not too easy to perform with the polymer in bale form. In our laboratory several means for approximating a condition of adequate dry premixing were devised. In one instance the polymer was sheeted to a thin gage in a cold mill and the carbon black peppered over the stock, which was then folded in a "jelly-roll" form prior to Banbury mixing. In another instance the rubber was diced to many small units and mixed with the carbon black before dumping into the Banbury.

The most successful method involved first dicing the rubber followed by blending with the carbon black, freezing the blend, and then grinding in a Mikro-Pulverizer[12] to a fine blended powder. After evaporation of the dry ice used for freezing, the finely divided blend of carbon and rubber was dumped into the Ban-

TABLE 6. DRY MIXING *VS.* WET MASTERBATCHING (BLACK RUBBER)

50 Phr. ISAF in SBR — Factory Mixing

Properties	Dry Mixing	Black Rubber
Modulus (L-300), psi.	1650	1720
Tensile, psi.	3475	3800
Elongation, %	535	545
Hardness, Shore A	55	56
Log R, ohms/cm.^{3}	4.0	4.0
Rebound, %	56.2	56.5
Mooney scorch, min.	22	15
Viscosity	50	53
Dispersion (photo)	6	9
Road wear	100	110
Cracking resistance	fair	good

TABLE 7. EFFECT OF DRY PREMIXING* PRIOR TO MASTERBATCHING

50 Phr. ISAF in SBR

Properties†	Regular Mix	Premixed First
Modulus (L-300), psi.	1930	1970
Tensile, psi.	3500	3800
Elongation, %	475	515
Hardness, Shore A	60	60
Log R, ohms/cm.^{3}	3.7	3.8
Rebound, %	53.5	53.0
Dispersion (photo)	4	8

*Mikro-Pulverized frozen polymer and carbon black.
†Average data from three Banbury mixes.

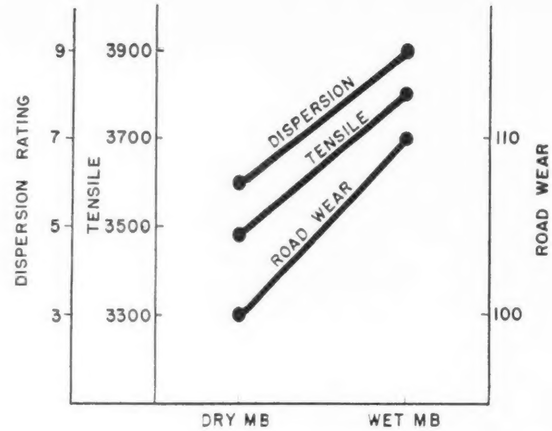


Fig. 15. Effect of dry mixing vs. Columbian process wet masterbatching on dispersion, tensile strength, and road wear of tires of 50 phr. ISAF in LTP SBR. Average of three tests

bury and otherwise handled in normal fashion. It was observed, as in the case of Columbian process black rubber, that the mixing time required to complete dispersion was only about one-half that required for a normal mix concurrent with a much faster temperature rise. Table 7 compares the properties of 50-part ISAF carbon in LTP SBR compounds prepared by the regular and dry premixing methods.

The results fall into the same category as the results for laboratory-mixed Columbian process black rubber stocks (see Table 5), with a marked increase in tensile strengths associated with a greatly improved dispersion. These results tend to confirm the conclusion that the most significant result in the Columbian black rubber process is improved dispersion with resultant striking increases in tensile.

Discussion of Results

The guiding principles for the dispersion of carbon black in various vehicles, expressed exactly two decades ago in the first publication from these laboratories (22),[11] apply with equal force today in the dispersion of carbon black in the variety of new rubbers.

"The application of colloidal principles has aided dispersion through recognition that the ultimate particles of carbon black when completely dispersed can be stabilized to prevent reagglomeration by the use of compatible vehicles or substances which act as dispersing agents. These agents, by altering the surface character of the carbon particles, reduce surface energies to a minimum and thereby stabilize them. In summing up, the recipe for successful and complete dispersion consists of (1) work, preferably by high viscosity milling, plus (2) stabilization, preferably by the use of compatible vehicles or selected dispersing agents."

In applying these principles to the problems of carbon black dispersion in rubber compounds it is essential that the instructions be interpreted correctly for the particular system under study. With regard to the work required, present rubber mixing equipment provides adequate means for breaking down the agglomerates of carbon black by high viscosity milling, provided, of course, this means is properly applied.

With respect to stabilization of the mechanically separated particles of carbon black, hydrocarbon rubbers do not require dispersion agents since they are not only compatible vehicles, but also act as peptizing agents for carbon blacks. Precautions must be taken, however, to protect the developing dispersion of carbon black during the mixing stage from the adverse effects of polymer degradation. Degradation of the polymer can develop from early excessive heat either by cross-linking to a high polymer gel level or by continued shearing to a resinous state—in either case the result is interference with the dispersion process, with a consequent final depressed state of dispersion. The precaution required is to keep mixing temperature reasonably low until the carbon black is uniformly dispersed and then permit an increase in temperature to insure adequate carbon-rubber bonding and completion of the carbon gel system. Heat therefore plays an important role in "fixing" the state of carbon black dispersion; its effectiveness is dependent on when and how applied.

The studies described in the present paper add interesting confirmation to these basic principles for dispersion of carbon black in rubber. The compatibility of carbon black and hydrocarbon rubbers is evident from the excellent performance of carbon black in all hydrocarbon polymers when compared, for example, to the difficulty in securing satisfactory results with

carbon blacks in certain non-hydrocarbon polymers such as silicone rubber.

The importance of high viscosity mixing, or the need of maximum mechanical work to break down the carbon black agglomerates, is evident from several phases of this study. All steps taken to increase the viscosity of the MB mix, such as higher carbon loading, decreased oil dosage, and higher viscosity polymers, resulted in improved dispersion.

A preliminary predispersion of the carbon black with rubber in the latex phase, the Columbian black rubber process, provides not only the initial work necessary to break down the carbon black aggregates, but also the intimate premixing required to avoid excessive polymer degradation in the mastication stage. A similar type of advantage results from the dry premixing of carbon black and polymer prior to masterbatching in the Banbury. The milling essentials for adequate dispersion of carbon black in rubber, then, are high viscosity in the masterbatch mix without initially high temperature, plus as much premixing of carbon and rubber as possible before milling to insure maximum carbon-rubber bonding and minimum rubber degradation.

The fixing or stabilizing of the carbon black dispersion by heat should follow the development of an adequate dispersed condition during the early stages of mixing. This preferred approach has been discussed in previous publications (21),[11] in connection with the investigation of carbon-gel development in SBR systems. As demonstrated throughout these studies, steps that develop an improved state of dispersion in rubber compounds result in improved physical properties of the vulcanizate, in terms particularly of tensile strength, elongation, tire wear, and resistance to cracking.

Summary and Conclusions

Techniques for investigating the dispersion of carbon black in rubber compounds at magnifications from 40 to 25,000 are described. By this examination of dispersion in depth the overall state of dispersion can be adequately evaluated in all polymers.

The photographic method for evaluating state of dispersion is particularly adaptable to SBR tread stocks and is considered adequate to predict with some degree of certainty the probable performance characteristics of tread compounds.

For carbons coarser than the fully reinforcing blacks, as well as for polymers other than SBR, the light microscope method is recommended for a preliminary evaluation of the state of dispersion. The X-ray method is especially recommended for the study of unvulcanized stocks and non-carbon components.

In all instances, for a complete evaluation of the state of dispersion, the lower magnification methods should be supported by an electron microscope examination.

The role of various processing and compounding factors in the control of dispersion has been investigated, with several masterbatching methods shown to be outstanding for the development of improved dispersion of tread carbons in SBR rubbers.

The correlation of state of dispersion to vulcanizate properties reveals the most striking effect of improved dispersion to be enhanced tensile properties, which in the case of tread stocks are associated with improved wear performance.

Acknowledgment

Grateful acknowledgment is made to various members of the microscope and rubber laboratories for assistance on the experimental work, and to A. Harvitt, vice president of Columbian Carbon Co., for permission to publish this paper.

New Polyethylene Antioxidants

The Bell Telephone System has used polyethylene for sheathing and insulating cable and cable conductor since 1941. During the last decade polyethylene became available in commercial quantities, and the subsequent growth in its production and use has been spectacular.

Polyethylene has one serious weakness: it oxidizes readily. Research chemists at Bell Laboratories have studied the oxidation of polyethylene in detail for some years and recently reported a whole new series of antioxidant compounds which, when added to polyethylene, will counteract serious oxidation for more than 20 years. This work is reported in the September, 1958, issue of the *Bell Laboratories Record* by F. H. Winslow.

Nearly all commercial antioxidant compounds belong to two chemical families, phenols and aromatic amines. The compound 2,6-di-(tert. butyl)-p-cresol is representative of the phenol class, and N,N′-di-phenyl-p-phenylenediamine is representative of the aromatic amines.

W. L. Hawkins and V. L. Lanzo, of Bell Laboratories, found the compound, 4,4′-thiobis-(6-tert.-butyl-m-cresol), consisting of two phenolic units joined by a sulfur bridge, to be particularly effective as an antioxidant for polyethylene in the presence of carbon black. The sulfur bridge served two functions. It increased the activity of the phenolic units, and, more important, it improved the antioxidant activity of the phenolic units in the presence of carbon black. When the OH groups in the compound were replaced by a hydrogen atom, the protectant completely lost its antioxidant activity. This showed that except for its added antioxidant activity in combination with carbon, the sulfur compound acted as a typical phenolic antioxidant.

The basic antioxidant molecule, but with a double sulfur bridge, for example, phenyl disulfide, although no longer a phenol, is effective when used with carbon black. Many additional types of molecules containing sulfur or selenium behave like the phenyl disulfide. Some of these molecules are polymeric substances and have the added advantage of remaining in the polyethylene longer than small molecule protectants.

NEWS of the

RUBBER WORLD

There are increasing evidences that the business upturn is becoming general. Shipments of replacement tires seem headed for a record this year. August new rubber consumption of 110,000 tons was the highest this year except for January. The upturn should be aided by federal spending in fiscal 1959 of about $95 billion.

The Labor Department's public hearings in October are aimed at developing a minimum wage regulation under the Walsh-Healey Act for the tire branch of the industry. Industry opposition is being coordinated through the Rubber Manufacturers Association and legal and economic counsel for the industry.

R. P. Dinsmore, Goodyear vice president, sees possibility of natural rubber shortage eliminated by increased synthetic rubber production facilities abroad. World synthetic rubber capacity in 1960 is estimated at 2,925,000 tons, and consumption at 2,058,000 tons.

Tyrex, a new cellulosic tire cord, said to have demonstrated extraordinary capabilities in tests by leading tire and automotive manufacturers has been announced by American Tyrex Corp. This non-profit organization, formed to promote use of the new yarn, is composed of American Enka Corp., American Viscose Corp., Industrial Rayon Corp., Beaunit Mills, Inc., and Courtaulds (Canada), Ltd.

Phillips Petroleum Co. says that its cis, 1,4-polybutadiene, now called "Cis-4" rubber, outperforms natural rubber in passenger-car and truck-tire treads. Development quantities of Cis-4 rubber are to be available by the end of the year.

U. S. Rubber's new Low Profile U. S. Royal Master tire is said to be capable of sustained operation at the maximum performance limits of any American passenger car now in production.

B. F. Goodrich Chemical Co. has announced the completion of a $3-million plant for its Carbopol water soluble polymeric thickening, dispersing, and emulsifying agent.

MEETINGS

and REPORTS

Goodyear Medal Award to Patrick; Rubber Division Elects Officers

The seventy-fourth meeting of the Division of Rubber Chemistry of the American Chemical Society was held in Chicago during the week of September 8 as part of the 134th meeting of the parent Society. The Rubber Division met on September 10, 11, and 12 at the Hotel Sherman, with about 900 members and guests in attendance. Registration for the Society was near 11,000.

The highlight of the Rubber Division meeting was the 1958 Charles Goodyear Medal Award to Joseph C. Patrick, discoverer and pioneer in the production of Thiokol synthetic rubbers. (See cover illustration.) Other features were the election of new officers and directors for 1959, approval of changes in the by-laws of the Division, and the award for the best paper presented at the Cincinnati meeting in May to Gerard Kraus and R. L. Collins, both of the Phillips Chemical Co.

A special feature of the Chicago ACS meeting was the Golden Anniversary celebrations of the Divisions of Agricultural & Food Chemistry, Fertilizer Chemistry, Industrial & Engineering Chemistry, Organic Chemistry, and Physical & Inorganic Chemistry. Also, E. J. Crane, editor of *Chemical Abstracts*, who will retire on November 1 after 48 years of service to the profession and the ACS, was honored at an informal banquet on the evening of September 10.

In addition, the National Chemical Exposition was held at the International Amphitheater during the week, with more than 120 leading firms in the chemical industries displaying their products and equipment. This Exposition is arranged by the Chicago Section of the Society.

The success of any meeting is dependent on the local committee on arrangements, and the Rubber Division officers headed by R. F. Dunbrook, Firestone Tire & Rubber Co., paid special tribute on several occasions to the Chicago local committee chairman, A. E. Laurence, Phillips Chemical, and V. J. La Brecque, Victor Mfg. & Gasket Co., as vice chairman, for their work.

25-Year Club Luncheon-Meeting

The regular luncheon-meeting of the 25-Year Club of the Rubber Division was held on September 10, with Charles M. Baldwin, United Carbon Co., as chairman for the meeting in Chicago. After welcoming the members to the meeting Mr. Baldwin asked H. A. Winkelmann, Dryden Rubber Division, Sheller Mfg. Corp., to conduct the elimination contest for the member present with the longest record of service in the industry.

Dr. Winkelmann first called on E. B. Busenburg, The B. F. Goodrich Co., secretary of the 25-Year Club, who called attention to the roster of members supplied those attending the luncheon through the courtesy of United Carbon and Mr. Baldwin.

A moment of silence was then observed in memory of Raymond L. Lasser, of Harwick Standard Chemical Co. and a member of the Club, whose death occurred on August 10.

After welcoming new members of the Club, the member present with the longest period of service in the industry was found to be J. E. Warrell, Carlisle Rubber Co. (48 years in the rubber industry), and Mr. Warrell was presented with a suitable memento of the occasion.

It was announced that E. G. Partridge, University of Southern California, would be the chairman for the next meeting of the 25-Year Club to be held at the time of the Division's next meeting scheduled for Los Angeles, Calif., May 12-15, 1959.

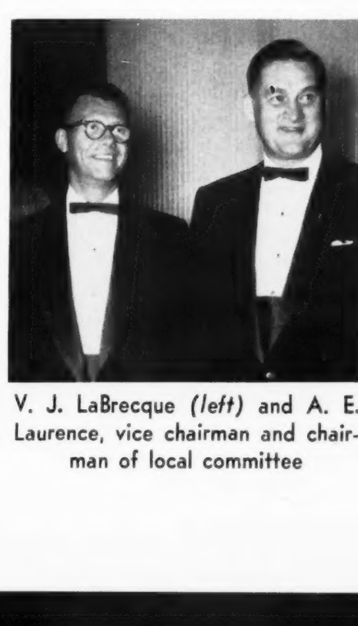
Technical Sessions

The Rubber Division technical sessions began on the afternoon of September 10 with R. F. Dunbrook, Division chairman, presiding. Dr. Dunbrook in his opening remarks recalled the last Chicago meeting of the Division, which was held in 1953.

The chairman mentioned the International Rubber Conference to be held in Washington, D. C., November 8-13, 1959. This Conference is a joint effort of the Rubber Division, ACS; the D-11 Rubber Committee of the American Society for Testing Materials; and the Rubber & Plastics Division of the American Society of Mechanical Engineers. The announcement of this Conference and initial solicitation of papers were mailed in May, but receipt of titles for papers due on October 1, 1958, has not been up to expectations, and Dr. Dunbrook urged Division members and others who plan to participate in this Conference to send in their titles as soon as possible and to arrange for abstracts to be forwarded by January 1, 1959, to the Conference program chairman, Dr. B. S. Garvey, Jr., Pennsalt Chemicals Corp., 813 Lancaster Pike, Wayne, Pa., U.S.A.

Abstracts of papers presented at the Chicago meeting were published in the July, 1958, RUBBER WORLD, beginning on page 583.

In a paper at the first technical session entitled, "Accelerated Testing of Ozone Cracking Inhibitors," F. B. Smith and W. F. Tuley, Naugatuck Chemical Division, United States Rubber Co., stated that the accelerated ozone box test method should be supplemented by other definitive tests such as the outdoor dynamic test for complete evaluation of antiozonants.



V. J. LaBrecque *(left)* and A. E. Laurence, vice chairman and chairman of local committee

1958 Division Chairman R. F. Dunbrook presents Cincinnati-meeting Best Paper Award to Gerard Kraus

E. H. Krismann, 1959 Division chairman, admires Medalist's scroll

G. E. Popp *(left)* and R. H. Gerke *(right)* reelected treasurer and secretary, respectively

At this same session B. A. Hunter and others of Naugatuck Chemical stressed the adverse influence of excessive use of sodium chloride as a flocculating agent for styrene-butadiene rubber, in a paper on the effect of stabilizers and flocculation techniques for SBR.

Although the cost of rubber vulcanization by atomic radiation may be too high for several years, the savings possible with this method are numerous and include those which could result from the high-speed, continuous-flow advantages of radiation cures, according to Dale J. Harmon, B. F. Goodrich Research Center.

Extraordinary ozone resistance was claimed for the new highly saturated adduct polymers (butadiene-mercaptan adducts) by G. E. Meyer and others of the Goodyear Tire & Rubber Co.

Recent advances in molding prepolymer-based urethane foam and the effects of core molding on finished article weight and physical properties were discussed by R. E. Knox, elastomer chemicals department, E. I. du Pont de Nemours & Co., Inc.

Tests of dynamic properties of elastomers measured continuously with temperatures that closely approximate service conditions were explained by A. D. Dingle and N. S. Grace, of the Dunlop Research Center of Canada.

In the field of high temperature-resistant rubber compounds the papers by F. M. Smith and W. A. Smith, of Firestone, on *Hevea* and butyl rubber compounding and processing; by D. J. Buckley and R. E. Clayton, Esso Research & Engineering Co. on the new MD-551, a chlorine containing butyl rubber; by Robert A. Hayes, Firestone, on butadiene-methacrylic acid copolymers; and on Viton fluoro-elastomer, by workers at Du Pont's elastomer chemicals department, were of special interest.

A paper by K. C. Beach and coworkers at Goodyear, on the Banbury processing characteristics of styrene-butadiene and nitrile-butadiene rubbers, included a simple and rapid quality control test based on measurement of power consumption in the Banbury mixer as the rubbers are mixed with carbon blacks under controlled conditions.

Papers on tire cord adhesion and new adhesives for adhering Dacron polyester fiber to rubber attracted considerable interest. Silicones Division, Union Carbide Corp., announced the development of a nitrile-silicone rubber with exceptional solvent and high-temperature resistance. The value of *cis*-polybutadiene, when mixed with natural rubber for truck tires, was emphasized by Phillips Petroleum Co., which claimed that such mixtures outperformed natural rubber in such tires.

At the final technical session on Friday morning, September 12, E. H. Krismann, the 1959 Division chairman, presented Dr. Dunbrook, the retiring Division chairman, with a plaque in token of the Division's appreciation for his services during 1958.

Other ACS Papers

Certain papers and programs of other Divisions of the Society should be of special interest to RUBBER WORLD readers and will be mentioned briefly for further possible investigation.

The Division of Industrial & Engineering Chemistry, in connection with its Golden Anniversary Celebration, held a "Symposium on the Impact of Government Research and Development Programs on American Science and Technology," on September 9. C. C. Furnas, University of Buffalo, presided, and several speakers reviewed the impact of government research on the universities, industry, contract research organizations, and on the growth of knowledge.

In another special program the five divisions celebrating their fiftieth anniversary at Chicago arranged a "Symposium on the First 50 Years of the First Five Divisions," at which eminent scientists discussed such subjects as the nature of matter, energy sources, measurement and instrumentation, mathematics and computers, and the technical man. D. O. Myatt, Atlantic Research Corp., presided at this symposium.

The Division of Paint, Plastics & Printing Ink Chemistry included in its Chicago meeting program a "Symposium on Foamed Plastics." Papers on urethane, vinyl, styrene, and latex rubber foams were part of this symposium.

The Division of Chemical Marketing & Economics had a program on urethanes, in the form of a "Symposium on Marketing and Economics of Urethane Materials." Both rigid and flexible urethane foams and raw materials for their manufacture were discussed at this symposium.

The Division of History of Chemistry in a "Symposium on Company Anniversaries" included a paper entitled. "Lee—75 Years of Rubber Manufacture," by W. B. Dunlap, Jr., Lee Rubber & Tire Corp., and a paper, "Goodyear's First 60 Years," by H. R. Thies, Goodyear Tire & Rubber Co.

The Division of Polymer Chemistry included a "Symposium on Polyether and Condensation Polymers," and a "Symposium on Inorganic and Other High-Temperature Polymers," in its extensive Chicago meeting program.

Goodyear Medal Address

In his 1958 Goodyear Medal Award address before the Division on the morning of September 11, entitled "Comments on the Polysulfide Polymers," Dr. Patrick first described how a Mr. Mnookin and he were operating the Industrial Testing Laboratory, Inc., in Kansas City, Mo., and how he (Dr. Patrick) became interested in trying to hydrolyze ethylene dichloride to the glycol in high yield. Although he did not succeed in this effort, he did discover that when sodium polysulfide was used, a smooth exothermic reaction took place, and when all the organic halide was exhausted, a solid rubber-like material was produced. Further examination of this material showed that it was stable, unusually solvent resistant, tough, and resilient. It was at about this time that the term "Thiokol" was coined for the material.

Dr. Patrick went on to describe further work in developing the processing and curing of Thiokol polysulfide polymer during the late 1920's. He mentioned the interest of Standard Oil Co. of Indiana and its vice president, R. E. Wilson, during 1927 and 1928, and the contract agreement for financing further research, which was terminated, however, in 1928.

In 1928 the late Bevis Longstreth, then president of Western Salt Co. in Kansas City became interested in Thiokol polysulfide rubber and was able to secure funds for further research by virtue of the formation of the Thiokol License Co.

Means of producing Thiokol rubber in the dispersed form were discovered, and a plant for commercial production was established in Kansas City, and

synthetic rubber was offered for the first time on the American market. Owing to difficulties with the Pendergast political machine in Kansas City, however, it was necessary to move the plant to another area. Longstreth and Patrick leased a vacant rubber plant in Yardville, N. J., and moved there in November, 1930. It was at that time that the Thiokol Corp. of Delaware was set up and took over the assets of Thiokol License Co.

Further research led to increased knowledge on the structure of the polysulfide polymer and means of improving elasticity and reducing its odor. It was determined that dichlorodiethyl formal was the most satisfactory material for reaction with polysulfides, and the formal disulfide polymer was such a great improvement that production and sales increased significantly.

During the middle 1930's an arrangement was made with Dow Chemical Co. by which large-scale manufacturing operations were transferred to Midland, Mich., while research, development, and sales were carried on at Yardville. Thiokol Corp. headquarters were transferred to its present location in Trenton, N. J., in 1938, and somewhat later the arrangement with Dow was terminated, and manufacture was started in Trenton.

Research work aimed at developing polysulfide elastomers with improved cold-flow properties resulted in the development of the use of sodium sulfite in the manufacturing process, and highly plastic polymers with good compounding and processing characteristics and greatly improved resistance to cold flow became available. A by-product of this line of investigation was the development of liquid polymers, and this expanded the field of applications of polysulfide polymers to calking compounds, sealants, elastic putties, etc., Dr. Patrick said.

It was these Thiokol liquid polymers that opened the way for the Thiokol Chemical Corp.'s entry into the field of rocketry and missiles since it was found sometime after World War II that these liquid polymers were useful for rocket propulsion. Thiokol Chemical Corp. has now expanded into six major divisions serving hundreds of industrial users of polysulfide polymers and is also maintaining and increasing its already commanding position in the field of rocketry and missiles.

The Medalist concluded his address by commenting on the length of the road from the first blob of brownish rubbery gum in a small Kansas City laboratory to participation in the flight of manmade satellites. He said it was a long road studded with rugged crossings, but that it was lots of fun.

John Crosby, president *(right)*, and S. M. Martin, Jr., vice president *(left)*, Thiokol Chemical Corp., congratulate 1958 Goodyear Medalist, J. C. Patrick *(center)* with Certificate of Award

The Business Meeting

Chairman Dunbrook presided at the business meeting of the Division on the morning of September 11. He first asked the members present to observe a moment of silence in memory of those members who had passed on since the last meeting of the Division. Those members were G. G. Balazs, Goodyear; Theo. G. Daub, Jr., B. F. Goodrich; Elmo E. Hanson, Firestone; J. M. Jackson, Detroit Arsenal; A. Morton, Rubber & Latex Products, Inc. Chemico, Inc., and Harrison-Morton Laboratories; and A. J. Kearfott, General Motors Corp.

It was announced that Wesley S. Coe, Naugatuck Chemical, and J. D. D'Ianni, Goodyear, would replace H. I. Cramer, Pennsalt Chemicals, and J. M. Ball, Midwest Rubber Reclaiming Co., respectively, as ACS councillors in 1959. Also, L. V. Cooper, Firestone, was reappointed, and Ralph B. Appleby, Du Pont, was appointed to the finance and budget committee of the Division.

The executive committee of the Division voted to include the recently organized Southern Rubber Group among the sponsored local rubber groups, raising the total of such sponsored groups to 15.

Dr. Dunbrook then asked E. H. Krismann, Division vice chairman, to read the report of the committee on by-laws headed by Waldo Semon, Goodrich. Amendments proposed and approved by the members were as follows:

The dues of members of the Division were increased from \$4 to \$6 a year, and the dues of associate members from \$6.50 to \$8.50 a year. Subscription to *Rubber Chemistry and Technology* was increased from \$7.50 to \$9.50 a year, for those who are not members or associates and subscribe only to the Division publication.

Dues cover membership through February 28. Division membership is automatically terminated on April 15 if current yearly dues are not paid by that date. After April 15 an extra fee of \$1 will be charged members and \$1.50 associate members who desire reinstatement.

The secretary, the treasurer, the assistant treasurer, and the business manager of *Rubber Chemistry and Technology* shall be bonded in amounts to be determined from time to time by the executive committee.

The executive committee shall consist of the officers and directors of the Division, the councillors, the assistant treasurer, and the editor of *R C & T*.

The chairman shall appoint, with the approval of the elected members of the executive committee, an assistant secretary, an assistant treasurer, and an assistant business manager of *R C & T*. Such appointments shall be effective for no longer than one year, and each shall serve until his successor is appointed.

The assistant treasurer shall, in addition to assisting the treasurer, serve as business manager of *R C & T*. The assistant business manager of *R C & T* shall serve as advertising manager.

The chairman, vice chairman, immediate past chairman, and secretary of the Division, and the editor of *R C & T* shall serve as a papers reviewing committee.

Changes in the by-laws with reference to the nomination of the Charles Goodyear Medal Award were rather lengthy and will not be repeated in detail here since they did not change the intent of the previous by-laws, but were merely for purposes of clarification.

The appointment of George Hackim,

General Tire & Rubber Co., as assistant business manager of *R C & T* was announced.

The Best Paper Award was presented to Gerard Kraus, Phillips Petroleum, by Chairman Dunbrook for the paper given at the Cincinnati meeting in May, 1958, by Dr. Kraus and R. L. Collins and entitled "Odd Electrons in Rubber Reinforcing Carbon Blacks." [This paper will be published in a future issue of RUBBER WORLD—Ed.]

The results of the election for officers and directors of the Division for 1959 were announced as follows: chairman, E. H. Krismann; vice chairman, W. J. Sparks, Esso Research & Engineering Co.; director-at-large, J. H. Ingmanson, Whitney-Blake Co.; secretary, R. H. Gerke, U. S. Rubber; and treasurer, G. E. Popp, Phillips Chemical.

Directors elected from areas of the sponsored local rubber groups were: *Akron*, S. C. Nicol, Goodyear; *Boston*, B. H. Capen, Tyer Rubber Co.; *Buffalo*, E. F. Sverdrup, U.S. Rubber Reclaiming Co.; *Canada*, O. R. Huggenberger, Dominion Rubber, Ltd.; *Chicago*, H. D. Shetler, Chicago Rawhide Mfg Co.; *Fort Wayne*, M. J. O'Connor, O'Connor & Co., Inc.; *Los Angeles*, C. E. Huxley, Enjay Co.; and *New York*, W. M. Gall, Luzerne Rubber Co.

Division Banquet

More than 500 members and guests of the Division enjoyed one of the finest of its banquet programs on Thursday evening, September 11. This affair was held in the ballroom of the Hotel Sherman and was preceded by the suppliers' cooperative cocktail party in the Exhibition Hall of the hotel. The banquet program included an excellent dinner, presentation of the Charles Goodyear Medal and scroll to Dr. Patrick, and a fine program of variety entertainment.

Chairman Dunbrook in his introductory remarks thanked the local committee for its part in making the Chicago meeting an outstanding success and then introduced the officers, directors, and guests at the head table. He welcomed the Southern Rubber Group as the latest sponsored group of the Division and introduced its representative at the meeting, John Bolt, Naugatuck Chemical.

John Crosby, president, Thiokol Chemical Corp., spoke on the 1958 Goodyear Medalist. He described Dr. Patrick as a rugged individualist and reviewed his career beginning with his service in the Army Medical Corps in World War I, his work in South America for Armour & Co., and his return to the United States in the 1920's to establish the Industrial Testing Laboratory, Inc., Kansas City, where the discovery of Thiokol polysulfide rubber was made.

Mr. Crosby made some corrections and additions to the history of the development of Thiokol rubber as described by Dr. Patrick in his Goodyear

Fabian Bachrach

W. J. Sparks, Esso Research & Engineering Co., chairman-elect

Medal address early on the same day. Crosby suggested that it was during the testing of some Scotch whiskey by Industrial Testing Laboratories for the late Bevis Longstreth during the Prohibition era that the Thiokol Chemical Corp. was actually born.

Mr. Crosby paid tribute to the foresight and industry of Dr. Patrick which has paid off so well in the success of Thiokol polysulfide rubber and the Thiokol Chemical Corp.

B. S. Garvey, Jr., chairman of the Goodyear Medal Award Committee, presented the Medalist to Dr. Dunbrook, who then awarded Dr. Patrick the Charles Goodyear Medal for 1958, the scroll, and the honorarium. Dr. Patrick in his acceptance expressed his appreciation for the honor accorded him by the Division.

Twelfth Akron Polymer Lecture Group Series

W. F. Watson, of British Rubber Producers' Research Association, inaugurated the twelfth annual series of the Akron Polymer Lecture Group on August 14 with a discussion of "Polymeric Reactions Induced by Mechanical Deformation."

The lecture series, conducted under the auspices of the University of Akron, Akron, O., will continue once a month until May, 1959, with meetings beginning at 8:00 p.m. in Room 107, Knight Hall, University of Akron.

The eight remaining speakers and the subjects of their lectures follow:

October 10: David S. Breslow, Hercules Powder Co., "A Soluble Catalyst for the Polymerization of Ethylene."

November 7: Waller George, Celanese Corp. of America, "Stereospecific Olefin Polymers."

December 5: John F. Brown, Jr., General Electric Co., "Polymerization in Canal Complexes."

January 9, 1959: Paul J. Flory, Mellon Institute, "Chain Configuration and Elasticity."

February 6: Thor L. Smith, Jet Propulsion Laboratory, California Institute of Technology, "Mechanical and Physical Chemical Properties of Diisocyanate-Linked Elastomers."

March 6: R. E. Hughes, University of Pennsylvania, "Helical Structures in Crystalline Polymers."

April 3: J. R. Pailthorp, E. I. du Pont de Nemours & Co., Inc., "Viton Fluorocarbon Elastomers."

May 1: P. M. Elliot, Naugatuck Chemical, division of United States Rubber Co., "Plastics Can Be Tough."

Inquiries should be directed to Dr. K. W. Scott, Program Chairman, Research Laboratory, The Goodyear Tire & Rubber Co., Akron 16, O.

Phillips Cis-4 Rubber Betters NR in Tires

Phillips Petroleum Co., Bartlesville, Okla., has announced that its *cis*, 1,4-polybutadiene, now called Cis-4 rubber, outperformed natural rubber in passenger-car tire and truck tire treads in recent tire test programs carried out cooperatively by Phillips and Armstrong Rubber Co. Cis-4 rubber gave as much as 30 to 40% longer tread wear in passenger-car tires and remarkable tread wear in truck tires with less heat generation than for corresponding sizes of natural rubber tires, it was said.

The Cis-4 rubber outperformed natural rubber not only in treads made from the new rubber alone, but also in blends containing up to 50% natural rubber in an especially severe truck-tire test program run on a test fleet operated by Armstrong near San Antonio, Tex.

Discovery of Cis-4 rubber was first announced by Phillips in April, 1956. The segment of the market now occupied by natural rubber is what Phillips will be shooting for when Cis-4 is commercialized, and the new rubber is expected to augment Phillips established synthetic rubber operations with no adverse effects on them, according to Phillips officials. It was pointed out also that synthetic polyisoprene may at best be expected to equal natural rubber; while Cis-4 rubber shows up better than natural rubber in heat build-up and tread wear tests.

Phillips plans to expand pilot-plant production of Cis-4, and tire test work will be accelerated. The company hopes to make development quantities of the rubber available to fabricators by the end of the year.

DKG May Meeting Abstracts

At the 1958 Rubber Conference of Deutsche Kautschuk-Gesellschaft (German Rubber Society),[1] held in Cologne, Germany, May 7-10, several papers were given by American and Canadian rubber technologists. Abstracts of most of these papers have been obtained from the authors and are reproduced herewith.

Vulcanization of Styrene-Butadiene Rubber by Gamma Radiation. P. M. Arnold, G. Kraus, and H. R. Anderson, Phillips Petroleum Co., Bartlesville, Okla.

Vulcanization of SBR by gamma radiation was described, and the results on a tread compound were treated in detail. A relation was shown to exist between the physical properties of the vulcanizates and the kind of cross-linking that takes place. Measurements of swelling and stress relaxation indicate that cross-linking is not accompanied by excessive chain-breaking, also that the excellent stability of mechanical properties during aging is due to the prevention of after-vulcanization by curing agents. At equal degree of cross-linking, irradiated rubber shows similar properties to those of sulfur-cured rubber.

Gamma radiation overcomes the retarding effect on vulcanization of some inorganic fillers and improves their efficiency as reinforcing materials. The high radiation dose needed for vulcanization can be considerably reduced by the use of heavy metal fillers in the mix; reduction depends on the atomic number, concentration, and particle size of the filler.

Deutero Rubber. Waldo L. Semon and David Craig, B. F. Goodrich Co. Research Center, Brecksville, O.

For many years the importance of deuterated rubber has been recognized. It might serve as a type compound for infrared and as a tracer rubber for learning about the plastication, vulcanization, and aging of rubber.

Early work failed to find a catalyst to replace the hydrogen in natural rubber by deuterium from heavy water. The discovery of the *cis*-1,4- polymerization of dienes by means of a Ziegler-type catalyst made possible the preparation of deutero rubber from deutero isoprene. Furthermore, such preparation gave information regarding the initiation of the polymerization.

Acetone-d_6 was reacted with acetylene-d_2 and KOD. The dimethyl ethinyl carbinol-d_8 so formed was deuteriumated to dimethyl vinyl carbinol-d_{10}, which dehydrated smoothly to isoprene-d_8. Polymerization by means of a catalyst made from trialkyl aluminum and titanium tetrachloride yielded deutero rubber.

This rubber was vulcanized and infrared spectra obtained. X-ray diffraction of crystalline samples showed the rubber to be isomorphous with natural rubber.

The physical properties of the intermediates and of the rubber were reported.

The Colloid Phase Carbon Reinforcement of Rubber. H. A. Braendle, G. L. Heller, and J. W. White, Columbian Carbon Co., New York, N. Y.

By recognizing the time factor in colloidal reactions, a significant improvement in the carbon reinforcement of rubber has been effected. Tread wear improvements of 15% over dry mixing have been confirmed. Further study on the process has revealed unexpected processing advantages. The range of processable carbons has been extended to full SAF.

Some of the unexpected advantages of the Columbian black rubber system were given as follows: (1) Less sensitivity to factory processing variables, both time and temperature. (2) By separating the mixing and bonding phases of black incorporation into rubber (at least for butadiene-type synthetic rubbers), the otherwise deleterious effects of cross-linked, unpigmented polymer are minimized. (3) By eliminating dispersing agents, the carbon-rubber affinity or bond is developed in full. (4) By accomplishing an otherwise unattainable dispersion of the carbon in rubber, a more uniform and advantageous distribution of the carbon gel throughout the cured rubber is possible. (5) The Columbian process has thus significantly extended the usefulness of carbon black in rubber since neither the black nor the rubber is subjected to the damage of severe high viscosity milling. (6) By blending masterbatches of high and low black concentration the number needed to cover the gamut of commercial rubber is reduced to reasonable proportions.

The Influence of the Chemical Nature of the Surface of a Filler upon Its Reinforcing Properties. M. C. Brooks, F. W. Boggs, and R. H. Ewart, United States Rubber Co. Research Center, Wayne, N. J.

The results of an experimental study designed to establish the effect of the chemical nature of filler surface on reinforcement properties were reported. The surface of silica fillers was modified by reaction with organo silanes. It was demonstrated that chemical bonding of filler and elastomer could be achieved and was necessary to get reinforcement similar to that obtained from carbon black. The chemical bond between filler and elastomer was achieved through condensation of unsaturated organo silanes on the surface of hydrated silica fillers, and subsequent covulcanization of the unsaturated filler surface and elastomer.

Vinyl and allyl unsaturation on the filler surface was found to bring about maximum reinforcement in natural and butadiene rubbers, but the less reactive cyclohexenyl unsaturation on the filler surface brought about maximum reinforcement in butyl rubber.

The reinforcement due to chemical bonding of filler and elastomer is demonstrated by improvements in performance of vulcanizates containing treated filler when compared to vulcanizates of the same elastomer containing untreated filler. These improvements include increased modulus, increased tensile strength particularly at high temperature, lower permanent set, improved abrasion resistance, better resistance to fatigue, and lower hysteresis.

Properly treated fine particle silica was found equal to fine particle carbon black in reinforcement properties, and properly treated kaolin was found equal to large particle carbon blacks.

Practical methods of obtaining these improvements in reinforcement have been developed through the use of compounding agents which react with the surfaces of the fillers during the course of normal compounding. These new compounding agents are described.

The Union of Butyl Rubber with Carbon Black. D. C. Edwards and E. B. Storey, Polymer Corp. Ltd., Sarnia, Ont., Canada.

The formation of butyl rubber-carbon black complexes may occur by physical or chemical processes and result in enhanced physical properties in the vulcanizates. It was shown that a union of the butyl rubber and carbon black occurs during mixing operations and that the development of such attachments is increased by the action of heat and chemical promoters.

An extraction procedure was employed to determine quantitatively the amount of low molecular weight (circa 12,000) butyl rubber that was insolubilized by union with carbon black. The insolubilization of the polymer occurs independently of polymer gelation, and the degree appears to vary directly with the square root of the molecular weight of the butyl rubber. At an average molecular weight above about 100,000, the polymer chains are sufficiently large to result in a continuous polymer-carbon network in the case of a 50 phr. EPC carbon black compound.

The observed quantity of bound polymer may be approximated by the volume of a shell around the carbon particles: the thickness of the shell is defined by one-half the root-mean-square end-to-end distance of the randomly coiled polymer molecules that are in qualitative agreement with theory.

The union of butyl rubber and carbon black leads to improved particulate dispersion, as indicated by light transmission measurements.

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[1] RUBBER WORLD, Mar., 1958, p. 890.

Evidence was given indicating the continued existence of strengthened rubber to carbon attachments in the vulcanizate. By measuring the increase in volume of FT black loaded compounds with increasing strain, it was shown that vacuole formation around the carbon particles is greatly reduced by heat-treatment procedures. Such a reduction must be due to enhanced rubber to carbon forces.

The effects of bound rubber and increased dispersion on the stress-strain and hysteresis properties of the vulcanizate were discussed.

Recent Butyl Rubber Advances in the United States. J. L. Ernst, Esso Research & Engineering Co., Linden, N. J.

The most noteworthy advances in butyl rubber technology in the United States during the past few years are being made in tire applications. In addition to expected improvements in ozone resistance, aging, flex cracking, and tearing, other major advantages such as reduced noise level, improved riding comfort, traction and braking on virtually all types of road surfaces have been achieved.

Most of the problems encountered in the early stages of butyl tire production have been overcome through improved compounding and processing techniques, and by the development of a butyl rubber latex now available in pilot-plant quantities.

Many of the performance characteristics of the all-butyl tire have also been achieved by a compromise tire structure, in particular, a tire incorporating a butyl tread on an SBR or natural rubber carcass. Butyl has also been used in tubeless tire liners in the United States. These two developments have been stimulated by the development of halogenated butyl polymers more compatible with other elastomers.

At present, butyl tires are being built and marketed on a trial basis in the United States. It is suggested that the heat resistant properties of butyl may provide in the near future more durable butyl tires than those made from present-day tire elastomers.

Through the recent development of improved compounds and processing techniques, faster extrusion and cure rates are now possible, and the use of butyl rubber for low-voltage cable insulation, where cost considerations are of major importance, has been accomplished. Another new and interesting area is that of insulating transformers and electronic parts. In these applications the butyl vulcanizate serves as a housing as well as the insulation media. Encapsulation of component electronic parts, also under investigation, offers unique possibilities.

The use of butyl rubber in mechanical rubber products has increased 200% in the last three years because of its inherent properties and improved compounding methods for compression set, processability, and variations in dynamic properties. Butyl rubber is used in the automotive industry primarily for its excellent weathering and shock-absorbing properties. Its remarkable resistance to synthetic detergents has led to the use of butyl in home appliances, and its damping ability is being utilized for noise elimination in refrigerators and air conditioners.

The use of butyl for heat-resistant belting is increasing, and, more recently, butyl belting has been developed for food handling because of its resistance to natural fats and greases. The improved adhesions available with butyl latex may make possible the use of butyl in belts requiring a higher level of adhesion.

In the United States, butyl rubber has become truly an enginering material as techniques and materials have been developed which complement butyl.

Rubber Flex Testing with Biaxial Straining. S. D. Gehman and C. S. Wilkinson, Jr., Goodyear Tire & Rubber Co., Akron, O.

When rubber is stretched, there is an alinement of the molecules or fibering so that the strength in the longitudinal direction is greater than in the transverse direction. In some types of service, such as in the sidewalls of tires, rubber goes through complex, two-dimensional cycles of deformation of such a nature that fatigue failure may involve this fibering tendency, the persistence of some fibering for a very short time after retraction and the fatigue resistance transverse to the direction of fibering.

Exploratory tests were made with a small machine in which a square-sheet test piece was mounted and subjected to cycles of extension in two perpendicular directions. The phase of the two motions could be varied by means of cams. The failure originated at a pinhole put in the center of the sheet. Alternate stretching in two directions was more severe for fatigue resistance than in-phase two-way stretching and much more severe than one-way stretching.

The results were of sufficient interest that a larger, four-position machine was built, with such features as temperature control and automatic counting and stopping at the end of a test. Investigations of the fatigue characteristics of rubber undergoing alternate, biaxial straining have been carried out with this machine. The testing procedures were discussed, and studies of the effects of testing and compounding variables with this new method of flex testing were presented for some typical rubber compounds.

Performance Characteristics of Synthetic Rubber in Tires. T. A. Riehl and V. F. Giulitto, Goodyear.

With the increased usage of tires on a worldwide basis, synthetic rubber must, of necessity, play an increasingly important role in order to meet these demands. Projected production estimates of natural rubber for the next several years show no potential increase, and we must, therefore, depend on synthetic rubber to make possible the estimated increases for the tire industry during this period. In both the United States and Canada, large amounts of SBR have been used successfully for a considerable period of time. On the other hand, in the European market, natural rubber has been used almost exclusively up until quite recently.

Our extensive experience with SBR rubber, and this includes the oil-extended polymer as well as both hot and cold rubber, has given us the opportunity to evaluate these types under many different service conditions. SBR has been used not only successfully, but actually to an advantage in the treads and sidewalls of passenger tires where the superior tread wear advantages, resistance to tread cracking, and improved weather aging, have all promoted its continued usage. Cold rubber and, more recently, oil-extended polymers have given particularly outstanding tread wear results.

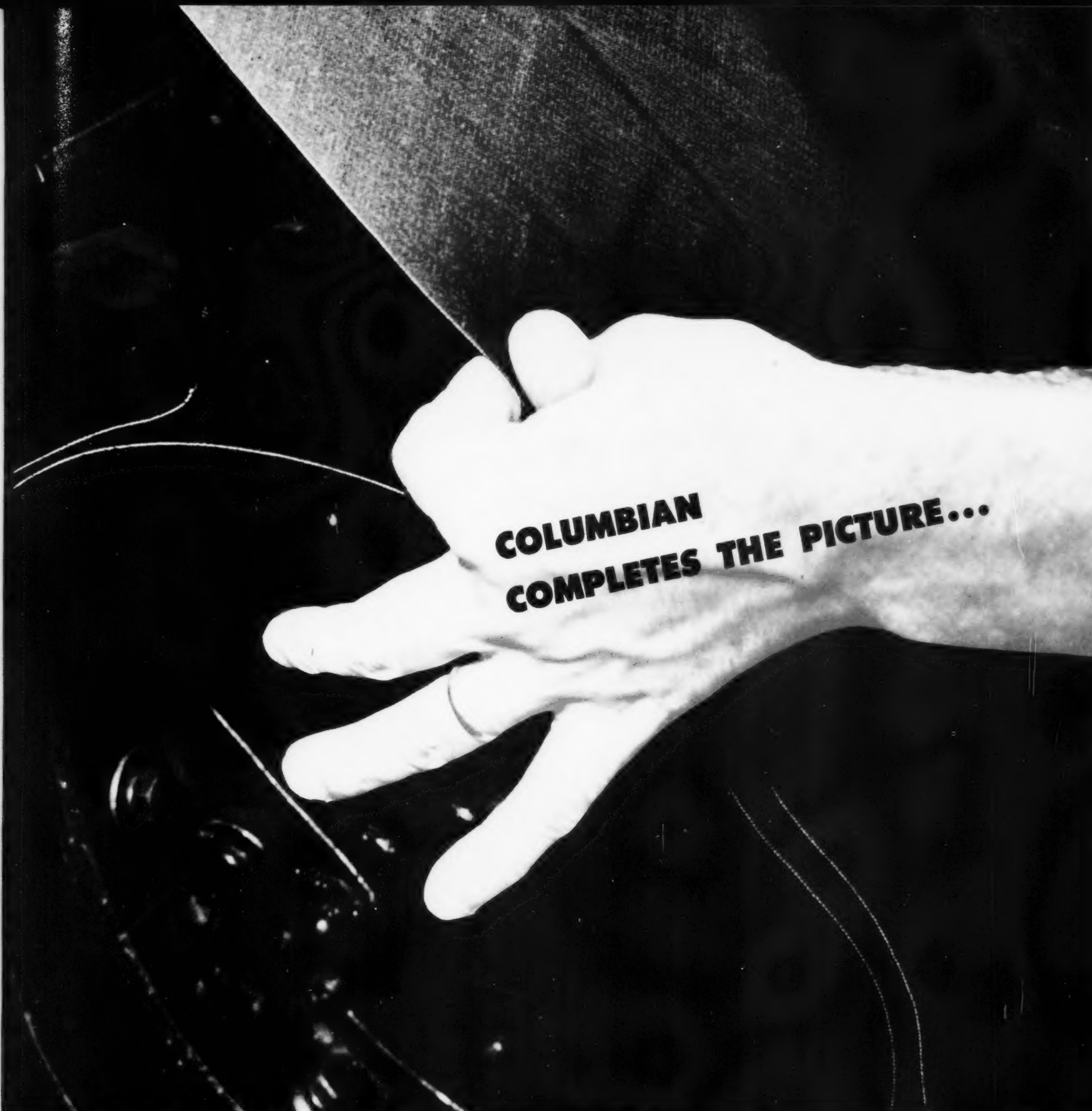
The disadvantages of poorer rolling resistance and traction on snow or ice of SBR have been eliminated to a certain extent with more recently developed polymers as well as by the use of furnace carbon blacks. Although a loss of traction was found at the lower temperatures, the reverse is true under more normal atmospheric conditions, and on wet roads SBR treads actually have better stopping ability than natural rubber treads. In certain other uses, particularly in carcass compounds, and also in treads for small truck tires, SBR and natural rubber can often be used interchangeably, with little effect on tire performance.

Where heat build-up is a problem, as in larger-size truck tires, the use of SBR usually results in somewhat poorer tire performance. Although the partial substitution of synthetic rubber for natural can be made without adversely affecting the performance of the tire, such a move would be dictated by the relative supply and cost situation.

In addition to SBR, other synthetic rubbers are being used in tires or are being evaluated for possible future use. The present status of this development program was also covered in this paper.

NCRG Honors Past Presidents

Past presidents of the Northern California Rubber Group were honored at the first meeting of the 1958-59 season, held September 11 at the Berkeley Elks Club, Berkeley, Calif. The guests of honor were Ralph Hick-



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TURN PAGE

cox, Oliver Tire & Rubber Co.; Halsey Burke, Burke Tire & Rubber Co.; Russell Kettering, Oliver Tire; Herman Jordan, E. I. du Pont de Nemours & Co., Inc.; George Farwell, Goodyear Tire & Rubber Co.; Donald Good, American Rubber Co.; Fred Swain, R. D. Abbott Co.; Ross Morris and Jos. Hollister, both of Mare Island Naval Shipyard; and James Stull, retired.

Following the dinner and business meeting, Orlando M. Breese, staff speaker for the National Association of Manufacturers, presented a talk entitled, "What Is America?" This inspirational address called on all Americans to exercise fully the rights which we are so fortunate to have. The speaker stressed that government must be supported by the people; that it should not become a super-entity capable of supporting them; and that it should not become a supplier of either goods or services which the individual or community can provide more adequately for themselves. He stated that people throughout the world should have the same rights that we in America have; and that we have neither the right nor the responsibility to force people to accept our ideas; but that it is our responsibility and privilege to furnish to the world an example of a society where one is for all and all is for one.

The group is holding dinner-technical meetings on October 2 and November 13 at the Berkeley Elks Club; and its annual Christmas party at the Orinda Country Club on December 6.

Summer Outing

Prime steaks barbecued in western family style were served at the annual summer outing of the group held September 6 at the Little Hills Ranch near San Ramon, Calif. Chairman for the affair was Ray Brown, of Burke Tire. The activities which included swimming, softball, volley ball, and kiddie games were highlighted by a gentlemen's foot race. First prize, a regulation football, was won by Vic Carriere, Mansfield Tire & Rubber Co.

Evans Lecture Series

Larry Walker, Oliver Tire, has announced that the second annual Leonard Evans Lecture Series commenced October 7 at 7:00 p.m. in Room 127, Dwinell Hall, University of California, Berkeley, Calif. Registration for the series is $5.00. The six weekly lectures in this series are on the following subjects: statistical control testing; special elastomers, Adiprene, fluorinated elastomers and silicone; hydrocarbon plasticizers and softeners; reclaimed rubbers; antioxidants and antiozonants; and accelerators and vulcanizing agents. Each session consists of a lecture followed by a question-and-answer period during which the speaker will serve as moderator.

Arrangements committee members, Connecticut Rubber Group

Connecticut RG Outing

The Connecticut Rubber Group held its thirteenth annual outing at Grassy Hill Park, Derby, Conn., on September 6, with 159 in attendance. The outing committee consisted of Otto J. Lang, KBC Industries, Inc., chairman; Wayne Perkins, Armstrong Rubber Co., treasurer; and of the various games committee members. The day's program included horseshoes, bocci, softball, field events, and the giving of prizes to everyone who attended. Special field event prizes were also given, the majority of which consisted of liquor.

ACC&CE Symposium

A symposium, "What's New in Chemistry," will be held during the thirtieth annual meeting of the Association of Consulting Chemists & Chemical Engineers, Inc., October 28, at 3:00 p.m., at the Biltmore Hotel, New York, N. Y. Letterhead reservation in advance, $15.00 per person, including cocktails and banquet, must be received not later than October 22. Registration is at 2:30 p.m. Ladies are welcome.

Speakers will be: Walter J. Murphy, editorial director, ACS Applied Journals, on "The Western European Chemical Industry in the Post-War Era"; Will Shearon, *Industrial and Engineering Chemistry;* Robert T. Gibbs, *Analytical Chemistry;* Rodney N. Hader, *Agricultural and Food Chemistry;* and R. L. Kenyon, *Chemical and Engineering News.* Moderator will be Foster Dee Snell, president, Foster D. Snell, Inc.

The symposium is open to industry representatives and all others interested. Letterhead reservation with remittance must be received by the Association, 50 E. 41st St., Rm. 82, New York 17, N. Y., before October 22. The meeting is informal. The annual business meeting, for Association members only, will be held same date and place, preceding the symposium.

WRG 1958-59 Plans

The Washington Rubber Group has announced that its plans for the 1958-59 season will include its anual dinner-dance to be held at the Touchdown Club on October 20; a field trip to the wire and cable plant of Western Electric Co., Baltimore, Md., on November 3; a meeting at the Army-Navy Club on February 2, 1959, at which Brig. Gen. Richard Hayward, USMC (ret.) will talk on "The New Defense Department"; and a meeting on April 6 and another on May 4 for which no details have been announced.

New officers for the 1958-59 season are as follows: chairman, R. D. Steihler, National Bureau of Standards; vice chairman, Arthur W. Sloan, Atlantic Research Corp.; secretary, Frank Shaw, Navy Bureau of Ships; treasurer, Jack Britt, The B. F. Goodrich Co. Thomas A. Tharp, The General Tire & Rubber Co., is chairman of the program committee; membership chairman is Harry L. Downey, Firestone Tire & Rubber Co.; and publicity chairman is John F. King, RUBBER WORLD.

At the October 20 dinner-dance the outgoing chairman Doug Bonn, United States Rubber Co., will report on WRG activities during his term of office, and the new chairman, Dr. Stiehler, will discuss in more detail plans for the new season.

Phila. Golf Outing

A record attendance of about 350 members and guests enjoyed the annual summer golf outing of the Philadelphia Rubber Group held August 22 at the Manufacturers Country Club, Oreland, Pa. Swimming, tennis, and a putting contest were also part of the program.

T. N. Loser, Wyrough & Loser, was in charge of the golf tournament in which 191 members and guests participated. Low gross winners (members) were Wes Curtis, Naugatuck Chemical Division, United States Rubber Co.;

Hank Pryor, R. E. Carroll, Inc., was second; and John Powless, Carlisle Tire & Rubber Co., third. Bill Pender, General Magnesite & Magnesia Co., was the low gross winner for the guests.

Other golf winners were as follows: closest to pin, (member), Frank Raba, Triangle Conduit & Cable Co.; (guest), B. Van Arkel, Walker Bros. Longest drive, (member), John Stiff, Columbian Carbon Co.; (guest), George Sella, American Cyanamid Co. Calloway contest winners were: W. Chamberlain, Armstrong Cork Co., first; Lee Keefer, Naugatuck Chemical, second; and Bill Brackett, Okonite Co., third, among the members. Dick Protis, Artloom Carpet Co., was first; Sandy Kerr, John A. Roebling's Sons Corp., second; and F. Newton, Robert Gair Division, third for the guests in this contest.

J. H. Carroll, R. E. Carroll, Inc., was the winner of the drawing for clubs conducted by the club pro.

In addition to the golf prizes, winners of various other events were awarded prizes after dinner, and all present received table favors of a cigarette lighter and Mr. and Mrs. wallets. A prize drawing saw the grand prize of a portable television set go to D. Funk, B. F. Goodrich Co., and 12 smaller prizes were also awarded.

Ontario Group Holds Annual Golf Outing

The Ontario Rubber Group held its most successful golf outing on September 19 at the Dundas Golf & Country Club, Dundas, Ont., Canada, with nearly 200 members and guests present, of whom more than 100 played golf. Dinner in the spacious and comfortable facilities of the newly completed Curling Rink was preceded by a cocktail party.

The Canada Carbon Black Trophy for low gross, donated by Ross Denis, of Canada Carbon Black, was presented by last year's winner, C. Pavanel, B. F. Goodrich Chemical Co. to Dick Knowlton, B. F. Goodrich Co. of Canada, for his 75. Other prize winners were: second low gross, G. Hillebrecht, Kaufman Rubber (Ontario), Ltd.; third low gross, Bob Lovell, Goodrich of Canada; first low net, Carl Croakman, Columbian Carbon of Canada; second low net, D. Bregman, Goodrich of Canada; and third low net, Bill Oliver, Sun Oil Co.

Included among the winners of golf events were A. Faris, Goodrich, for the greatest improvement, and M. A. Duncan, Gutta Percha & Rubber, Ltd., for the greatest relapse. T. Wood, of Kingsley & Keith, had the high score.

At the conclusion of the dinner, the Group president, Mr. Croakman, expressed the thanks of the executive committee and the recreation committee to the more than 85 donors whose generosity provided more than enough fine prizes for all the winners of the golf tournament and also enabled almost everyone present to win a door prize.

A vote of thanks was extended to the recreation committee headed by Lloyd Lomas, St. Lawrence Chemical Co., and committee men Bob Klingender, Gutta Percha & Rubber; Roy Patterson, Dunlop of Canada, Ltd.; and Dean O'Rourke, W. C. Hardesty Co.

NBS Radioisotope Standards

The National Bureau of Standards, Washington, D. C., has discontinued the distribution of the following radioactivity standard samples of longer-lived radioisotopes which are now commercially available: NBS Standard Sample No. 4910 Radium D-Radium E; No. 4911 Radium D-Radium E; No. 4912 Radium D-Radium E; No. 4913 Cobalt-60; No. 4914 Cobalt-60; No. 4915 Cobalt-60; No. 4919 Strontium-90/Yttrium-90; No. 4920 Thallium-204; No. 4928 Sulfur-35; No. 4931 Cesium-137/Barium-137; No. 4934 Tantalum-182; and No. 4936 Iron-59.

Standardized samples of these nuclides may be obtained from the Nuclear-Chicago Corp., Chicago, Ill. The standards to be issued by this firm will be derived from comparisons made with the national standards maintained by the National Bureau of Standards. The firm, however, has accepted full responsibility for the standardization of the samples that it distributes.

Discontinuance of this activity will permit the Bureau to devote more of its resources toward meeting the demands of science and industry for new and more accurate standards. The Bureau will, however, continue to maintain the primary disintegration-rate standards of these nuclides.

CALENDAR of COMING EVENTS

October 20-24
National Safety Council. Forty-Sixth National Safety Congress. Conrad Hilton Hotel, Chicago, Ill.

October 20-21
Instrument Society of America. National Rubber & Plastics Instrumentation Symposium. Akron, O.

October 21
Elastomer & Plastics Group, Northeastern Section, ACS. Annual Meeting. Science Park, Charles River Dam, Boston, Mass.

October 24
Philadelphia Rubber Group. Poor Richard Club, Philadelphia, Pa.
Akron Rubber Group. Sheraton-Mayflower Hotel, Akron, O.

October 28
Assn. of Consulting Chemists & Chemical Engineers, Inc. Thirtieth Annual Meeting: Symposium, "What's New in Chemistry." Biltmore Hotel, New York, N. Y.

October 30-31
International Symposium on Plastics Testing & Standardization. Benjamin Franklin Hotel, Philadelphia, Pa.

November 3
Washington Rubber Group. Field Trip to Western Electric Co., Baltimore, Md.

November 3-8
ISO/TC 61 on Plastics. Eighth Plenary Meeting. Washington, D. C.

November 4
The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.

November 6
Rhode Island Rubber Club.

November 13
Northern California Rubber Group.

November 14
Connecticut Rubber Group. Manero's Restaurant, Orange, Conn.
Chicago Rubber Group.

November 17-21
Eighth National Plastics Exposition. Society of the Plastics Industry. International Amphitheatre, Chicago, Ill.
National Plastics Conference. Hotel Morrison, Chicago.

November 21
Philadelphia Rubber Group. Dance. Manufacturer's Golf & Country Club, Oreland, Pa.

November 30-December 5
American Society of Mechanical Engineers. Annual Meeting. New York, N. Y.

December 2-4
Seventh Annual Wire & Cable Symposium. U. S. Army Signal Research & Development Laboratory, and Industry. Berkeley-Carteret Hotel, Asbury Park, N. J.

December 9
Buffalo Rubber Group. Christmas Party.

WASHINGTON REPORT

By JOHN F. KING

Evidence of Business Upturn General; Industry Sales, Profits Outlook Good

The recession of 1957-58, the year-long slide in economic activity, is over, and recovery is on the way, fast. This view is practically unanimous in Washington; economic thinking in the industrial centers of the country supports it.

Evidences of Upturn

Though still below the highs of mid-1957, industrial production is heading back to record rates. Government statistics also show that personal income in August had snapped back remarkably—to a record annual rate of more than $355 billion, or $3.5 billion above the historical high of August, 1957. The upsurge in income, which the government attributes to a slight gain in employment—though these figures show two million more unemployed than a year ago—seemed to be pulling with it more consumer buying.

This is the total picture as the economy headed into the fourth quarter of 1958 with a full head of steam: factory sales are rising; the decline in new business investment, thanks to heavy inventory liquidations in early 1958, has slowed down considerably; new housing starts in July picked up remarkably; and, most remarkable of all, there is in progress a phenomenal boom in federal government spending.

With this picture in mind it is understandable that economic pessimists are so hard to find. It also is understandable that the Federal Reserve Board, fearing another economic takeoff as occurred in 1955 with the resulting inflationary spiral, already is moving quickly to apply the brakes with monetary and credit curbs.

Effect on Rubber Industry

On three specific points in the itemized list of recovering sectors of the economy the rubber industry can take heart. First, the outlook for corporate profits, even in the recession year of 1958, is a vast improvement over early-year forecasts. There are estimates that corporations, as a whole, will make even more than in 1957 and perhaps as much as in 1956. From the industrial scientists' point of view this is good news. Corporate profits is business's key to research and development programming for the years ahead. When profits fall, research spending takes a tumble; when they rise, so does business spending on outlays for new techniques and products.

Second, there is the evidence, replete in rubber industry statistics, that the recession's impact on the marketing of replacement tires and tubes was practically nil. In fact, it looks as though replacement shipments this year will hit a record high. For the first half of the year, passenger tire replacements were nearly 30.9 million, compared to 28.7 million in the January-June period of 1957. Tractor-implement replacement tires jumped to more than one million during the period, compared to only 859,000 a year ago. In the first six months of this year, shipments of all motor vehicle inner tubes totaled 21.2 million, against 20.3 million in the same period last year. In the first six months of 1957, the industry shipped 201 million pounds of tread rubber camelback, but this figure jumped to nearly 213 million pounds in the period ended June 30, 1958.

Government experts acquainted with the affairs of the industry say it is quite possible that 1958 will be the best year ever for replacement tires. The outlook for original-equipment shipments is uncertain, however, since this requires a guess as to how well Detroit's 1959 models move. Recalling the "consumer revolt" against the 1958-model styling and pricing and considering that the new models are even flashier and more costly, the experts won't even try to guess.

Another year like last, when Detroit produced less than 4.5 million cars, would hit original equipment hard. Yet it is pointed out that the replacement tire boomlet would be unaffected except to the tire manufacturers' advantage—that is, more people deciding to keep their older cars means they sooner or later replace tires.

The observation also is made that a slack auto market has not been the only pinch on the rubber industry. Non-tire rubber product consumption also fell in the recession months, but as in other sectors of the economy, a general economy pickup will provide a tonic for industrial usage of non-tire products.

As the economic jargon has it, we've hit bottom and we're bouncing back.

The third and perhaps most significant factor in the situation that augurs better days ahead for the rubber industry and business generally is the literal outpouring of federal cash on current spending—for defense, agriculture, construction, and special payments such as social security, welfare, and veterans' programs. And the spending pace is accelerating.

The simple budget figures, released in September's midyear federal budget review, show the annual rate of federal expenditures soared from $79.9 billion last summer to $86 billion at the end of June. It is ironic to note from Budget Bureau figures that only half a billion dollars of the $6-billion increase was the result of deliberate, anti-recession pump-priming measures. Most of the $500 million in question went for special federal assistance to the states for unemployment compensation payments. The bulk of the increase thus reflected increases in government outlays that began when the Russian Sputnik went up last year and obliged the Eisenhower Administration to lift the lid on its defense efforts. Of course, the total $5.5-billion increase did not go into nuclear weapons and rocketry; the Agriculture Department got a good piece of it to meet new financial obligations created by bumper farm crops.

1959 Federal Spending

While no official forecasts of fiscal 1959 cash expenditures have been published, the government's budget experts have a good idea of what's coming. They intimate it will be bigger than the fiscal 1958 record peacetime outlays.

Although there is some hesitation to put the forecast of spending in terms of dollars and cents, the informal estimate is that the Federal Government by the time fiscal 1959 draws to a close next June 30 will have pumped $95 billion into the economy, over $10 billion more than in the fiscal period just ended. It is thought that in the April-June quarter of 1959, Uncle Sam will be spending at the annual rate of $100 billion.

The Commerce Department, in the third-quarter survey of business, estimates the federal spending spree in fiscal 1959 will produce $54.5 billion

in direct government purchases of goods and services. This is \$3.5 billion more than will be paid out on direct procurement in fiscal 1958. The department did not say so because complete data are not available, but it hinted that the gross national product in the current fiscal year—the sum total of the value of all goods and services in the country—will approach \$440 billion, up markedly from the annual rate of \$429 billion recorded in the "recovery" quarter of fiscal 1958 April to June.

Conditions for Tire Industry Minimum Wage October Hearings Set by Secretary Mitchell

Over the opposition of rubber industry management, the Labor Department in October will set the stage for the adoption of minimum wage regulations for the tire branch of the industry. No one can say at this point if a wage standard, or standards, will be promulgated for producers of tires, tubes, and camelback. But it is privately conceded that the way the Department is pushing for industry regulation, Labor Secretary James P. Mitchell probably will go along and approve a wage yardstick for the industry.

Hearings Begin October 8

The Secretary's final decision, of course, will be based on the record he will be presented with following an estimated three or four days of public hearings, beginning October 8 before a Department hearing examiner. This officer only presides over the hearings and passes the record of the meeting on to the Secretary without making any decision of his own. It is possible that the tire manufacturers' representatives may make a case against the adoption of minimum wage rules persuasive enough to deter the Labor Secretary from imposing regulations.

The tire producers oppose minimum wage regulation on the argument that the incentive pay system widespread within the industry does not lend itself to a minimum wage policy, and that the scores of rubber products manufactured by the employes of a tire manufacturer will present a confusing problem as to which employes are working under government contract.

Walsh-Healey Provisions

Under the Walsh-Healey Act, which provides the Labor Secretary with the authority to set minimum wage standards for an industry, the "prevailing wage" for workers in a given industry must be adhered to by every manufacturer who fills government orders of \$10,000 or more. If there is no compliance, there are no more government contracts for certain manufacturers.

The Walsh-Healey "prevailing wage" standard is not to be confused with the Fair Labor Standards Act "minimum wage." The latter nationwide standard is currently set at \$1 per hour. Under the Walsh-Healey standard, the floor wage can run anywhere between \$1 and \$3 per hour, depending upon the "prevailing" rate in an industry or a geographic area.

Four Main Issues

Assignment of the case to a hearing officer by Secretary Mitchell follows a long struggle by rubber industry management against the proceedings. During the Korean War the Department's Walsh-Healey Division began an investigation of prevailing wages in the industry, but this investigation was dropped. In early 1957 the Division made another pass at tire producers, but this second effort was also shelved. But in October of last year the Division cranked up the investigation again and appears this time to have made it stick, as evidenced by Secretary Mitchell's recent order for public hearings.

Assignment of hearings was preceded by a statistics-gathering operation undertaken late last year by the Walsh-Healey Division. Employment and wage data for the industry's payroll period ending nearest November 15, 1957, have been obtained, and any changes that occurred in the prevailing minimum wages since that time may be considered at the hearing.

Secretary Mitchell framed in his order the four main issues in the case as follows: (1) What is the "appropriateness" of the proposed definition of the industry? (Labor defines it as that which manufactures tires, tubes, and camelback). (2) What are the prevailing minimum wages in the industry? (3) Should there be a single determination for all the area in which the industry operates or separate determinations for smaller geographic areas (including the appropriate limits for such areas)? (4) Should there be included in any prevailing wage determination for the industry a provision for the employment of probationary workers at wages lower than the prevailing minimum wages, and on what terms or limitations, if any, should such employment be permitted?

Government sources indicate that while the four issues are formally the whole of the proceedings, they expect the greatest controversy will arise over these two basic issues: what the prevailing rate is to be, and whether there should be a nationwide rate or separate regional rates.

Industry opposition is being coordinated through the RMA and the industry's economic and legal counsels.

URW President Decries Anti-Union Sentiment

In a "state of the union" message to the United Rubber Workers (AFL-CIO) in September, President L. S. Buckmaster urged intelligent "political action" to protect the labor movement from "reactionaries in the United States who are embarked upon a campaign to weaken, if not destroy" unionism.

His appeal was made to 550 delegates, representing 200,000 union members, to URW's twenty-first convention held last month in Miami Beach, Fla. Now in his eleventh term as union president, Buckmaster in his annual report to the convention warned that the Taft-Hartley Law, state right-to work laws, "the anti-union bias of the present national administration," and the "strange behavior" of the National Labor Relations Board have combined to pose an ominous threat to union organizations and members.

Against the backdrop of the recent Congressional fight over the so-called Kennedy-Ives Labor Reform Bill, which would have required the disclosure of employe welfare-fund handling, Buckmaster claimed "Big Business" teamed up to defeat this legislation. He referred specifically to "reactionary organizations such as the National Association of Manufacturers, the National Chamber of Commerce, and their political henchmen in the national Congress and the state legislatures." The Kennedy-Ives Bill, frankly opposed by the Chamber and the NAM, was killed in the House late in the session after having been passed by the Senate by a wide margin.

"The thing that all of us must realize," Buckmaster told the delegates, "is that the campaign against unions is a campaign against working people, and that there is no intention on the part of labor haters to limit their efforts simply to the passage of unfair labor legislation."

The URW president asserted that the "wave of anti-union sentiment which has developed" is adversely affecting the URW, "although our union has an outstanding reputation as a clean, honest and patriotic organization." Coupled with this "wave" and working equally to the disadvantage of the URW, he continued, are "the depression, the propaganda campaigns, and the unfriendly attitude of the national administration."

Sounding the same theme in his convention report was the URW general vice president, Joseph W. Childs. URW members who fail to participate in union activities are playing into the hands of interests hostile to labor, he warned.

URW Secretary-Treasurer Desmond Walker reported that the URW's net worth as of June 30 was \$4.8 million, which is \$1.8 million higher than it was two years ago when the union's last convention was held.

INDUSTRY NEWS

FAO October Meeting Will Emphasize NR

The international Food & Agriculture Organization, a branch of the United Nations, predicts that natural rubber will be one of the most important commodities to be discussed at FAO's Southeast Asian meeting which is scheduled to be held in Tokyo, Japan, October 6-16.

Fifteen nations in the area, including the world's chief rubber producers, Malaya and Indonesia, will participate in the meeting. Other conferees will represent Burma, Cambodia, Ceylon, India, Japan, Korea, Laos, Nepal, Pakistan, the Philippines, Thailand, Viet Nam, and the United Kingdom. The UK will represent Borneo and Singapore.

In a brief forecast of some of the subjects to be discussed at this meeting, the FAO pointed out that last year's natural rubber production was about 1.9 million tons, nearly equal to the average for the two previous years. Output in Malaya increased considerably in 1957, but this gain was offset by the continued decline in Indonesian production.

FAO said that while output in other Asian countries remained more or less unchanged, African production kept advancing. It hazarded the guess that Africa "is likely to be competitive" with Asia in the period immediately ahead. FAO continued its comments on the natural rubber situation to say that experts believe that the world will use more rubber of both kinds (natural and synthetic) in 1958 than it did in 1957, although USA needs are likely to be lower. The USA will probably begin to use rubber more quickly toward the end of the year, and this increase in consumption rate is likely to continue into 1959. The major West European countries and Japan are expected to need just as much natural rubber as they have ben using, even though synthetic rubber producing capacity is increasing in Western Europe.

FAO added that the most significant increase in natural rubber requirements will probably be in the Soviet Union, which has been buying on a large scale through United Kingdom channels, but which has not turned to buying directly from the producing areas.

Consumption of natural rubber also changed little from the figure for the past two years. Although consumption fell off both in the USA and in the Soviet Union, it was maintained or even increased in other countries, and world consumption as a whole was about equal to production. For the beginning of 1957, natural rubber prices were fairly stable, but they fell off steadily from August onward and continued to fall early in 1958. By April, the price of natural rubber was about equal to the price of its synthetic competitor.

Dinsmore Sees Possible NR Shortage Eliminated; Makes New Use Estimates

Increasing activity in the construction of synthetic rubber production facilities in Europe, Japan, and elsewhere throughout the world will probably remove the possibility of a natural rubber shortage predicted some months ago,[1] according to R. P. Dinsmore, vice president, Goodyear Tire & Rubber Co., in a talk before Congres International de Chemie Industrielle, in Liege, Belgium, September 9. The subject of Dr. Dinsmore's talk was "Trends in the United States Rubber Industry," and he presented revised figures on total rubber consumption, the ratio of synthetic to the total rubber used, and an estimate of synthetic rubber capacity and use for major areas of the world.

The estimate of total new rubber consumption by areas, as given in Table 1, was prepared from information obtained from the *Rubber Statistical Bulletin* and various other sources including *Rubber and Plastics Age*, *Natural Rubber News*. The Rubber Manufacturers Association, Inc., the Goodyear business research department, and *Chemical Week*.

Dr. Dinsmore stated that if the estimated synthetic consumption as % of total is correct in Table 2, there will not be a shortage of natural rubber, unless the present rate of production of NR is decreased.

Although most of the new synthetic rubber production facilities being constructed abroad are for styrene-butadiene rubber (SBR), it was added that the % synthetic figures in Table 2 are based partly upon the expectation that synthetic polyisoprene will be available, in North America, at adequate cost and quality beginning in the early 1960's. Consumption of synthetic polyisoprene might reach 150,000 tons by 1965, Dinsmore said.

The availability of synthetic rubber by area is interesting and has a strong bearing on the future plans for the program for synthetic rubber production and use in the United States. Table 3 compares synthetic rubber capacity and consumption by areas through 1965.

[1] RUBBER WORLD, Oct., 1957, pp. 71, 107.

TABLE 1. WORLD TOTAL RUBBER CONSUMPTION BY AREAS

(1,000 Long Tons)

	1956	1960	1965
The Americas	1,633	1,765	1,940
Western Europe and UK	841	1,009	1,250
Eastern Europe	559	671	839
Rest of world	382	428	505
Total	3,415	3,873	4,534

TABLE 2. % SYNTHETIC OF TOTAL RUBBER CONSUMED

	1956	1960	1965
The Americas	57	60	70
Western Europe and UK	18.2	45	55
Eastern Europe	62.6	62.6	67
Rest of world	18.9	42	53
Weighted total	44.3	53	61.2
Total NR needed (1,000 l. t.)	1,905	1,815	1,655

TABLE 3. SYNTHETIC RUBBER CAPACITY AND USE

(1,000 Long Tons)

	1956		1960		1965	
	Cap.	Cons.	Cap.	Cons.	Cap.	Cons.
The Americas	1,508	935	1,900	1,060	2,550	1,360
Western Europe	25	153	325	450	475	688
Eastern Europe	n.a.	350	600	420	700	561
Rest of world	none	72	100	128	150	270
Totals		1,510	2,925	2,058	2,875	2,879

It was pointed out that the figures in Table 3 show that there will be a very large surplus capacity in the Americas (mostly SBR), a moderate excess in Eastern Europe, and a shortage of synthetic rubber in Western Europe. The projected increase in the Americas is expected to come about by the building of SBR plants in Central and South America and by the building of polyisoprene plants in the U.S.A. and Canada. If this trend works out as indicated, the United States will find an export market only because of superior quality and customer service and/or by the promotion of new rubbers with special properties.

Dr. Dinsmore explained that the total consumption figures in Table 1 exceeded previously published figures for 1960 and 1965, and that the new figures had been reached by using an expansion rate for countries other than those of the Americas of about 2½ times that of the latter. These new figures increase the estimated Western European market for synthetic rubber, but decrease the amount for sale from Eastern Europe.

Trends for butyl, neoprene, and nitrile rubbers were next examined. Butyl rubber capacity of 100,000 tons a year plus a possible additional 30,000 tons a year was compared with the present U.S.A. demand of 55,000 tons. Non-tire uses of butyl are increasing, but tire uses are not growing rapidly at the present time.

Neoprene capacity of 125,000 tons a year was compared with the present U.S.A. demand of 65,000 tons. In spite of its many desirable properties, no large increase in its use in the U.S.A. was foreseen.

The properties of nitrile rubbers were described, and the plant capacity of 65,000 tons a year was compared with the present use of 25,000 tons annually in the United States, without any estimate of future demand being made.

Newly developed synthetic rubbers such as Goodyear's butadiene-mercaptan adduct polymers were also described, but it was explained that so far very little commercial use has developed for this material.

In connection with synthetic polyisoprene, it was said that it now appears that it may be feasible to make isoprene at about the cost of butadiene which should make this polymer reasonably competitive with natural rubber. The high abrasion resistance of *cis*-polybutadiene was mentioned, and the possible place of this rubber in the American market is considered to be promising. Although silicone rubbers have developed a 2,200-ton-per-year consumption volume, it is difficult to see how these rubbers can achieve a very much larger volume, it was said. Acrylic rubbers have a limited consumption volume, but this is growing.

Urethane rubbers in the solid form have found only specialty applications in the United States in solid molded parts and some cases as coating made from liquid polymers. The most active development is the foamed urethane rubber. There are no reliable figures for the consumption of these rubbers, but the tonnage is not important as yet, the speaker declared.

Fluorocarbon rubbers are of great significance in that they will perform under conditions where other elastomers fail, but present indications are that these rubbers will be used in the limited volume accorded to highly specialized materials.

Thus, a review of the rubber demand in various parts of the world indicates that while most areas are becoming more self-sufficient with respect to their synthetic rubber requirements, there are still opportunities to supply both general-purpose and specialty types to some parts of the world. Development of new types of synthetic rubbers in the United States indicates the producers' willingness to provide rubbers to meet new conditions as they arise in industry. At least some of these specialty rubbers will undoubtedly broaden their scope as time goes on and will have a better opportunity to reach a limited, but less competitive foreign market. It is evident that before long the industrial countries of the world will be able to meet their rubber requirements with much less dependence upon the vagaries of plantation production in the Far East, Dr. Dinsmore said in conclusion.

Zielasko with "Tires"

Ernest H. Zielasko, formerly with The B. F. Goodrich Co., Akron, O., has succeded Phil Robinson as editor of *Tires-TBA Merchandising,* another Bill Brothers publication. Zielasko started with Goodrich in 1947 after graduating from Ohio State University. For two years he worked in the public relations and advertising divisions, then left to found a weekly newspaper, which he sold in 1951, when he returned to Goodrich. He then was made assistant editor of the plant newspaper and in May, 1952, was named editor of all sales publications for the company. In 1956 he was appointed an assistant to H. W. Maxson, public relations director. Zielasko is also a veteran of World War II.

Ernest H. Zielasko

Robinson, who became editor of *Tires* in 1954, has returned to the public relations field. His new job is director of public relations of American Tyrex Corp., manufacturer of tire cord, and of American Rayon Institute, both in New York, N. Y.

Ed Littlejohn, with *Tires* since 1955, first in an editorial and then in a sales capacity, has been made eastern sales manager; while Don Monaco, associate editor, has been named managing editor.

New salesman on the magazine is William G. Kelley, who was with Sinclair Refining Co. from July, 1950, to August, 1958, as retail sales representative, fuel oil representative, and assistant to the eastern division sales manager of tires, batteries, and accessories sales.

New Buell Classifiers

Buell Engineering Co., Inc., New York, N. Y., has announced a new centrifugal classifier system which separates dry fines from coarse materials at improved efficiencies. The new classifier has no moving parts, operates aerodynamically, requires virtually no maintenance, and utilizes but 0.04- to 0.5-hp. per ton per hour.

The classifier will extract from most feed materials more than 98% of the very fine particles having diameters smaller than 325 mesh (44 micron), with no oversize material in the fines. This device has increased mill outputs from 10 to 300%. It is available in sizes to handle from 100 pounds to 100 tons of feed material per hour and is particularly recommended for classification applications in the 200-400-mesh range. It is designed for use in classifying materials such as ores, mineral flowers, milled products, fillers, fibers, chemicals, resin powders, and others.

The firm also announced a new gravitational-inertial classifier recommended for applications in the 50-200-mesh (74 to 297 microns) range. Gravitational and aerodynamic forces are combined in this system to classify better than 95% of the feed material.

Further information on these classifiers and brochures on the firm's electric precipitators, cyclone systems, and dust collectors are available from the company.

Marvibond Process License in Japan

A process for bonding durable and decorative vinyl plastic sheet to metal on a continuous basis has been licensed by United States Rubber Co., New York, N. Y., to Nakanoshima Steel Co., Ltd., a division of Yawata Iron & Steel Co., Ltd., Japan's largest steel firm. Japan is the twenty-second foreign country in which the process, called the Marvibond process, has been licensed since it was introduced by the rubber company's Naugatuck Chemical division four years ago.

An engineering team from Nakanoshima is currently in this country being briefed on the laminating process. The Japanese firm plans to set up a laminating production line at its plant in Osaka, Japan, and has tentatively scheduled the line to start operating by late this year or early 1959.

The laminating process is a method for continuously coating metal with semi-rigid plastic sheets to give the metal an attractive and rugged finish before it is formed into products. Once coated, the metal can be formed, or fabricated, without damaging the plastic facing, according to the rubber company.

The laminate has been put to such uses as portable television sets, luggage, bridge tables, school and office furniture, and display cases. It is also being tried in submarines, tankers, trains, buses, the prototype model of a jet airliner, and in automobiles. Foreign applications include wainscotting in restaurants, theatres, and office buildings; housings for oil burners, washing machines, electric dryers and refrigerators; and tile roofing and building exteriors.

Nakanoshima plans to produce the laminate in sheet form which it will supply to fabricators. Applications for its material are expected to follow current uses in this country and overseas.

Firestone Licenses Truck Tire and Rim

The Firestone Tire & Rubber Co., Akron, O., has granted royalty-free licenses to the companies in the tire and rim manufacturing business to manufacture, use, and sell a new standard tubeless truck tire and a one-piece drop-center rim which it developed and for which it was issued a patent in December, 1957. These companies are members of The Tire & Rim Association, Inc., which has made this tire and rim an accepted standard for the industry.

Firestone announced that all of the tire and rim manufacturers in the United States have been informed that Firestone grants each company a non-exclusive, irrevocable, royalty-free license. The rubber company also offers tubeless tire production know-how acquired in its development of the new standard tubeless truck tire.

The new product includes among its features a 15-degree bead taper and a shortened bead and sidewall structure. These features are said to enable substantial savings in costs, both in tire production and operation.

The use of a one-piece, drop-center rim affords a lighter, unsprung wheel weight, avoiding road shocks and reducing rapid deterioration of wheels and axles. Truck fleet operators report that they have been finding savings in operation, and other advantages, in the use of the new tires and rims.

Foamed Plastics Production Up

The production of cellular plastics reached 31,500,000 pounds in 1957, according to J. R. Morton, newly elected chairman of the cellular plastics division of The Society of the Plastics Industry, Inc., and president of Morton-Withers Chemical Co., division of Chas. Pfizer & Co., Inc., Greensboro, N. C. This figure represents a production increase of approximately 97%, compared to 1956 output.

Cellular plastics, or foamed plastics, are produced from basic resins such as vinyl, urethane, polystyrene, phenolic, and polyethylene. Morton also predicts that total cellular plastics production will amount to approximately 50,250,000 pounds in 1958, or a gain of 59%.

Flexible foamed plastics are being used increasingly in such applications as cushioning materials in furniture; institutional seating; and in transportation seating in subways, railroads, buses, airplanes, and automobiles. These plastics also find applications for carpet underlay and items of wearing apparel, as well as for sun visors, arm rests, and crash pads in automobiles.

Rigid foams continue to be used principally in many kinds of insulation, packaging, exhibit and display materials, floral designs, and for flotation equipment and buoyancy applications in the marine industry.

It is estimated that flexible and rigid vinyl foam production, which amounted to approximately 4,500,000 pounds in 1957, will exceed 5,250,000 pounds during 1958.

Flexible and rigid urethane foam which amounted to about 12,000,000 pounds in 1957 should double production to approximately 25,000,000 pounds by the end of 1958.

Rigid polystyrene foam production was estimated at 15,000,000 pounds in 1957. It is expected that this figure will approach 20,000,000 pounds this year.

Mr. Morton, in his capacity as chairman of the cellular plastics division, also announced that the cellular plastics industry has developed and approved specifications and methods of test on flexible vinyl foam, flexible urethane foam, and rigid cellular materials. These specifications and test methods were recently approved by the American Society for Testing Materials, as well as the Joint ASTM-Society of Automotive Engineers Technical Committee on Automotive Rubber.

The cellular plastics division has also approved urethane raw material test methods and a number of vinyl foam raw material test methods. Copies of these specifications and methods of test may be obtained from the offices of the Society of the Plastics Industry, Inc., New York, N. Y.

Goodrich Announces New Carbopol Plant

Volume production of a fluffy white powder that improves the performance qualities of numerous existing products was announced September 17 by B. F. Goodrich Chemical Co., at a press conference at the Waldorf-Astoria Hotel, New York, N. Y. J. R. Hoover, president of the company, stated that a $3-million plant has been completed at Calvert City, Ky., for the production of the material, a water-soluble polymer called Carbopol.[1] The plant has an immediate capacity of 70,000 pounds a month.

Carbopol was described as the first of a family of polymers which are versatile agents for thickening, suspending, dispersing, and emulsifying. It is used to make cosmetics and toothpaste smoother, to eliminate drying and caking often found in creams and lotions, and to give good flow qualities to any paste or liquid dispensed from plastic bottles or tubes. This material is useful also in pharmaceuticals, polishes, waxes, inks, paints, waterproof and oilproof coatings, textile printing, and in industrial specialties, Hoover said, adding that Carbopol is non-toxic and is relatively unaffected by temperature and aging. Carbopol, properly neutralized, thickens synthetic rubber cements containing low percentages of rubber, making them more easy to handle and spread than conventional formulations.

The company foresees much larger commercial use for the product because new applications are developing daily, many of which it had not anticipated. The new plant at Calvert City has been designed so that capacity can readily be doubled and quadrupled as use of Carbopol spreads to other industries. Carbopol is the result of five years of research and development by the company and part of the firm's program to diversify and grow through products of its own creation.

[1] RUBBER WORLD, Aug., 1957, p. 740; Apr., 1954, p. 113.

Urethanes Use Cuts Application Costs

Lower-cost homes are in sight as a result of recent experiments with rigid urethane foam, it was revealed at a press conference at the Waldorf-Astoria, New York, N. Y., September 23, by Chester M. Brown, vice president of Allied Chemical Corp. He said that researchers in his company's National Aniline Division are working on a development of urethane foam-insulated and soundproofed sandwich panels that can be installed quickly in new homes, with important savings in building and labor costs.

Mr. Brown envisioned a house prefabricated to the extent that a mass-production line turns out panels with a finished outside wall, and a layer of rigid foam in between for insulation and structural strength. The panels will be mold, mildew, and fire resistant, he said.

This use is only one of hundreds of applications for urethane, both as flexible and rigid foam and as coatings, many of which are already on the market.

One principal chemical ingredient of urethane foam is Allied's chemical product called Nacconate diisocyanates. When this material is properly formulated with a plastic resin, water, and other chemicals, it was explained, a foam is produced which builds up to 30 or 40 times the volume of the ingredients within a few minutes. It can result in a rigid or flexible product.

Largest present use of flexible urethane foam is in cushioning. Heritage Furniture Co., High Point, N. C., has now opened a plant especially for processing urethane foam for this field.

However, the use of flexible urethane foam in interlinings for civilian and military use is expected to grow from an estimated one million yards this year to 15 million by 1960, according to O. M. Morgan, director of chemical sales for Allied's National Aniline Division.

Industry is said to be finding widespread uses for urethanes in applications such as airplane wingtips, where foam is poured into wingtips for added buoyancy and rigidity. A liquid coating of urethane, given the same wingtip, is said to provide excellent protection from rain-caused erosion.

Other applications include: urethane coatings to protect industrial equipment against chemical fumes, weathering, and excessive heat and cold; urethane-based paint claimed to be so hard spikes cannot injure it; patching materials for concrete highways; heart surgery and repair of broken bones and joint replacement; and in the tire, bedding, and boating industries.

RSA Begins Operations; New Centers Planned

The new Rubber Shippers Association, organized by The Rubber Manufacturers Assocation, Inc., New York, N. Y., earlier this year, consolidated and shipped in carload lots upward of 450,000 pounds of less-than-carload-lot freight on behalf of its members during its first month of operation, according to George E. Gwinup, vice president and general manager of the Rubber Shippers Association.

Shipments covered miscellaneous rubber products, including footwear, sundries, hose and belting, brake linings, hard rubber goods, foam and sponge products, and light mechanical goods, as well as plastics, chemicals, and electrical products. Economies resulting from the consolidations and carload operation in the shipment of these products from terminals in Boston, Bridgeport, and Pawtucket to West Coast destinations averaged about $1 per hundredweight, it was said by the R.S.A.

RSA expected to open its second LCL consolidating terminal in the Albany-Schenectady area in September and is now organizing to extend its services to members in the New York, Philadelphia, Trenton, and Baltimore areas, by January 1, 1959. It is expected that consolidating and shipping centers also will be set up in the Akron-Cleveland area shortly after the first of the year. Plans are being made to permit shipments from northeast areas to southwest destinations in the near future.

Verne Treadwell, traffic manager of National Carbon Co., Division of Union Carbide Corp., has been elected a member of the board of directors of RSA.

Carbon Plant Addition

Plans for an expansion project at Continental Carbon Co.'s carbon plant at Ponca City, Okla., which will expand that facility's furnace black capacity by 50%, were recently announced by that company and one of its parent organizations, Continental Oil Co.

Continental Carbon, which is headquartered in New York, N. Y., is owned by Continental Oil Co., The Shamrock Oil & Gas Corp., and Witco Chemical Co. In addition to Ponca City, it operates carbon black plants at Lake Charles, La., Eunice, N. Mex., and Sunray, Tex.

Work on the project, which will expand the plant's capacity from 50,000,000 pounds to 75,000,000 pounds annually of all grades of furnace black, will start within the next two months. Completion is expected by the fall of 1959.

Continental Carbon presently has a staff of some 45 persons at its Ponca City carbon black unit, which was completed in 1954. The plant addition will be devoted entirely to the production of premium-quality furnace black from oil furnished by Continental Oil's Ponca City refinery. Continental Carbon's products are sold through Witco Chemical Co., New York.

Harwick Appoints Six

Six new executive appointments were recently announced by Mrs. C. J. Harwick, chairman of the board of directors of Harwick Standard Chemical Co., Akron, O.

D. F. Behney, vice president of sales and a director since 1956, has been named executive vice president of this key supplier of chemicals to the rubber and plastics industries. William L. Lasser, purchasing agent and assistant warehouse superintendent, has been advanced to vice president in charge of operations. The board also elected Harvey G. Greer, who has been technical director, to the new position of vice president in charge of technical development.

At the Harwick manufacturing affiliate, Republic Dye & Chemical Co., Jack R. Moore, also president of Harwick, has been elected president. Frank A. Sancic has been made executive vice president, and Curtis J. Harwick, Jr., is vice president in charge of development.

"Grulla" Output Up

Sales averaging one pair for each family in the country is the figure being reached by the Wellco-Ro-Search affiliated factory in Colombia, S. A., Cia. de Productos de Caucho "Grulla" S. A., which began manufacturing footwear in 1954 under licensing agreement with the Waynesville, N. C., firm, with an initial production of 350,000 pairs for the year. These figures were doubled each year for the succeeding two years and are currently reaching the two-million mark. The country's population is about 12 million.

"Grulla's" chief mechanic, Ivan Arango, is now visiting the Wellco-Ro-Search plant in Waynesville to study the techniques of mold making for high-pressure molded vulcanization in "Process 82." Upon his return to Colombia the firm will begin production of the necessary equipment to set up its installation for manufacturing footwear by this process. Because of import restriction in that country, "Grulla" must manufacture all equipment of this type locally.

New Low Profile U. S. Royal Master Tire

United States Rubber Co., New York, N. Y., announced development of a low profile passenger-car tire, called the Low Profile U. S. Royal Master, at a press conference at the Detroit Athletic Club, Detroit, Mich., on August 27. The new tire, oval in cross-section and wider than it is high, is said to be capable of sustained operation at the maximum performance limits of any American passenger car now in production.

The new tire was made possible by four engineering achievements, according to G. R. Cuthbertson, vice president and general manager of the company's tire division: (1) the development of a deep, intricate mold design; (2) the development of the pressure tempering process which strengthens the tire by taking the stretch out of nylon cord, and removing the strains from tread and carcass rubber compounds; (3) the development of a new synthetic rubber compound in which the reinforcing carbon black is finely and evenly distributed throughout the rubber to give it greater strength and wear resistance; (4) The recent wide-scale conversion to automatic Bag-O-Matic tire curing equipment with its high steam pressure needed to shape and cure the wide, low profile tire.

The tire flexes less as it rolls than do conventional tires, making it smooth riding and cooler-running, especially at higher speeds. Its oval shape and long, low-angled nylon cord construction give it greater stability, according to the company.

The tire, combining maximum rim diameter with minimum tire height, offers the automotive engineer a means of lowering car height without reducing the wheel or brake diameter, an important safety factor. This tire is only 86% as high as it is wide in cross-section.

Original tread mileage of the tire is 36% more than the average of present first-line tires, claims U. S. Rubber. When the tread of this Royal Master is 75% worn there is still enough rubber left to allow its traction and skid efficiency to be renewed. In a road test against leading competitive makes of premium tires, the new tire showed 33 to 40% more mileage.

The tread of the tire is made up of thousands of cylindrically shaped elements which present biting edges in all directions. These traction elements support each other, yet are free to flex individually and easily conform to road irregularities.

Tests on wet, smooth concrete showed 30% better skid resistance for the new tire than for present first-line tires, 57% better breakaway traction, and 32% better sideway skid resistance.

The tire has a 1¼-inch white sidewall made of a synthetic rubber especially compounded to resist ozone deterioration. The sidewall is also protected against scuffing above and below by patented curb guards (see accompanying illustration).

New Low Profile U. S. Royal Master Tire. E. H. Wallace, tire development product manager, points calipers to two curb guards

The new tire, made in a full range of sizes to fit 15- and 14-inch rims, comes in tubeless form only, with nylon tire cords that have a tensile strength of 52 pounds, compared to 29 pounds for standard nylon tire cord. Extra thickness of the tread and the heavy nylon cord are said to prevent punctures by small objects. A special inner wall compound grips larger nails that might penetrate, preventing sudden loss of air, allowing driving for miles until repairs can be made.

U. S. Rubber believes that the new, low profile concept of tire design is so significant that it will be adopted generally by the tire industry in the future and that some low profile tires will be standard equipment on at least some 1960 cars.

Thiokol Gets Contract

Thiokol Chemical Corp.'s Reaction Motors Division, Denville, N. J., has been awarded a Navy prime contract for production of package liquid rocket engines. The contract, under cognizance of the Bureau of Aeronautics, covers production of the rocket engine, designated the *Guardian*.

This contract award represents the first military commitment for production of packaged liquid rocket engines, the design concept pioneered and developed by Reaction Motors. The engine, LR 44-RM 2, can be supplied in a fully loaded condition complete with propellants loaded at the factory. The *Guardian* engine is an integral unit which includes propellant tankage, thrust chamber, and all components necessary for its operation. This engine can be safely stored, fully loaded with propellants, for extended periods of time.

Manufacturing facilities have been established at Bristol, Pa., and Reaction Motors will also utilize manufacturing buildings of Hunter-Bristol, another Thiokol division, and production activities will operate as a branch plant of the Reaction Motors Division. E. Dana Gibson has been appointed plant manager of the new branch manufacturing plant.

Firestone in Portugal

The Firestone Tire & Rubber Co., Akron, O., has announced that construction of a new tire plant is under way in Portugal and that the plant is scheduled to go into operation in late 1959.

Formed by Firestone and a Spanish associate with Portuguese bankers and industrialists, the new firm will be known as Firestone Portuguesa. It will be located in Alcochete, on a tract of 93 acres near Lisbon, across the Rio Tejo. Annual production capacity will be 120,000 truck and passenger tires, including tubes.

Under its first six-year plan, to be completed this year, Portugal has undergone a substantial industrial expansion, adding several new industries to the country's roster of businesses. As an indication of her advance, Portugal and Portuguese possessions have more than doubled their registration of cars, trucks, and buses from about 112,500 in 1951 to 227,000 in 1958, it was reported.

Dixon Reelected

H. L. Dixon, of The B. F. Goodrich Co., was reelected president of the Rubber & Plastic Adhesive & Sealant Manufacturers Council, Newark, N. J., at a meeting of the group, September 10-12, at the St. Clair Inn, St. Clair, Mich.

Reelected with Dixon to serve through September, 1959, were L. R. Turner, of St. Clair Rubber Co., first vice president; N. L. Melbye, Angier Adhesives division of Interchemical Corp., second vice president; J. L. Been, Rubber & Asbestos Corp., third vice president; and B. F. Warmer, Coast Pro-seal & Mfg. Co., treasurer.

The officers also were elected to the organization's steering committee, along with F. M. Jeffe, of Pierce & Stevens Chemical Corp., and C. W. Walton, of Minnesota Mining & Mfg. Co.

The Council's next meeting has been scheduled for December 8-9 in the Shoreham Hotel, Washington, D. C.

New Voit Plant

The W. J. Voit Rubber Corp., a subsidiary of the American Machine & Foundry Co., on July 29 broke ground for a 60,000-square-foot factory and office building for Voit's tread rubber and tire repair materials division, at Santa Ana, Calif. The cement tilt-up style of structure will be one-story from outside appearance, but underground installation of heavy rubber processing equipment will make production an actual two-floor operation.

Completion of the building proper, on the 37-acre site, will take approximately six months; the installation of production machinery, an estimated additional six months. New equipment will include a #11 Farrel-Birmingham Banbury; a 15-inch F-B extruder; cooling conveyors; automatic slab cutting and stacking facilities; automatic carbon black handling equipment; and automatic oil handling equipment. Patents are being applied for on many of the novel features of the automatic oil handling equipment. Full operation of the new plant is scheduled for about July 1, 1959.

The plant is expected to be the industry's most efficient, utilizing the most modern rubber processing equipment. In many instances, particularly all phases of materials handling, full automation has been developed by Voit's engineering staff. Total investment for the building and equipment is set at $2 million.

Tyrex Yarn Announced; Firestone Reports Use

A new cellulosic yarn, said to be the result of a major breakthrough in cellulosic research, developed by members of American Tyrex Corp., New York, N. Y., exclusively for tire cord, was announced September 12 by William Dalton, president. The corporation has adopted Tyrex as the certification mark for the new yarn.

The new corporation, a non-profit organization formed to promote the use of the yarn, is composed of American Enka Corp., American Viscose Corp., Beaunit Mills, Inc., Courtaulds (Canada) Ltd., and Industrial Rayon Corp.

Tires made with Tyrex yarn and tested by leading tire and automotive manufacturers as well as independent automotive research organizations have shown extraordinary high-speed performance and tread wear characteristics, in addition to softer and quieter riding qualities, it is claimed. Tyrex tire yarn will be used in original equipment tires on 1959 automobiles. As soon as production capacity for the new yarn is increased, it will be available for replacement tires.

Firestone Tire & Rubber Co. announced in late September that Tyrex will be used in Firestone tires for 1959 model cars. President Raymond C. Firestone confirmed American Tyrex's statement that the new synthetic tire cord is much stronger than the rayon cord previously used in original equipment tires. A reduction in bulk combined with the increased strength of Tyrex permits construction of a safer, lighter, and cooler-running tire, Mr. Firestone said.

It was revealed that Firestone constructed tires of the new material about two years ago and that more than four million test miles on Firestone's proving grounds, on taxi fleets, over turnpikes, and on cross-country trips proved tires made with the new yarn to be far superior to the former rayon tire cord. The lighter weight and stronger tire cord gives the tire greater resistance to impact and a more flexible body for a softer ride. Additional tests rate the new Tyrex cord product as excellent on flex life, tread cracking, running noise, growth, and handling, it was added.

Record Conveyor Belt

What will be the longest slope conveyor system is now being installed at the Ishpeming, Mich., mines of Cleveland Cliffs Iron Ore Co. When installation is completed, the belt, made by United States Rubber Co., New York, N. Y., will have a center distance of 3,791 feet. It will carry 700 tons of low-grade taconite iron an hour, traveling at a speed of 460 feet a minute, an elevation of approximately 800 feet —a record in itself for a heavy ore lift by several hundred feet.

When all of the belting—a total of over 7,500 feet—is ready for use, the sections will be spliced together. The result will be a continuous belt carrying ore from 3,000 feet below ground to 2,200 feet below ground. Two 350-h.p. motors will power the three foot wide belt over its run.

The belt is made of U. S. Usrex nylon, an extremely strong synthetic fabric specifically designed for this application. Design requirements called for extreme flexibility since the belt is to be twisted on the return run between head pulley and tail pulley. The belt was made by U. S. for Link Belt Co.

NEWS BRIEFS

B. F. Goodrich Research Center, Brecksville, O., has developed a new family of rubber-like adhesives, said to be polymers with built-in adhesive characteristics. Known as B. F. Goodrich adhesive "A-916-B," the new material is now available as a laminating adhesive from the B. F. Goodrich Industrial Products Co., Akron, O. The pressure-sensitive thermoplastic material bonds new synthetic films to all kinds of metals as well as to paper, wood, glass, plaster, and other materials. "A-916-B" basically is a virtually colorless, transparent material, but it can be furnished in any color. It contains 50% solids.

Beebe Rubber Co., Nashua, N. H., has added the fourth addition in two years, a modern single-story ell structure, to its Nashua plant. It will link the administrative offices to the plant proper. Expansion was sparked through the manufacture of Ripple Sole, of which Beebe Rubber is the sole U. S. licensee.

The Firestone Tire & Rubber Co. of California recently held at its Los Angeles plant a ceremony marking its thirtieth anniversary and celebrating the production of its 55,000,000th automobile tire. Norris Poulson, mayor of Los Angeles, Burton W. Chase, Los Angeles County supervisor, and George B. Gose, president of the Los Angeles Chamber of Commerce, attended the event.

The Goodyear Tire & Rubber Co., Akron, O., has expanded domestic passenger-tire production to include Suburbanite winter tires for small foreign-made automobiles. Sizes are 5.20-13, 5.60-13, 5.90-13, 6.40-13, 5.00/5.25/5.60-15, and 5.50/5.90-15. All are rayon, tubeless, and black. Prior to producing these tires this year at its Topeka, Kan., and Akron, O., plants, the company had imported winter tires in the smaller sizes from its plants in Wolverhampton, England, Norkopping, Sweden, and Colmar-Berg, Luxembourg.

Union Carbide Chemicals Co., division of Union Carbide Corp., has doubled production capacity for acrylonitrile at its Institute, W. Va., plant. Acrylonitrile is used in the manufacture of acrylic fibers, high-impact resins, nitrile rubber, and new acrylonitrile derivatives. New terpolymers, made from acrylonitrile, butadiene, and styrene, are plastics having high-impact and high distortion strength.

Industrial Reactor Laboratories, Inc., Plainsboro, N. J., under a proposal of the Atomic Energy Commission, will be issued a license for operation of a research reactor. The company, an associate of 10 industrial organizations, is constructing a 5,000-kilowatt (heat) pool-type reactor on a 300-acre tract in Plainsboro Township, about four miles from Princeton, N. J. The facility is expected to provide fast and thermal neutron fluxes and gamma rays for a variety of experimental applications of interest to the associated firms. Associated in the project are American Machine & Foundry Co., American Tobacco Co., Atlas Powder Co., Continental Can Co., Inc., Corning Glass Works, National Distillers & Chemical Corp., National Lead Co., Radio Corp. of America, Socony Mobil Oil Co., Inc., and United States Rubber Co. AMF Atomics, a division of American Machine & Foundry Co., has been engaged to undertake initial operation of the reactor.

B. F. Goodrich Industrial Products Co., Akron, O., has manufactured a 42-inch wide belting which is being used in a conveyor installation hauling 20 million tons of selected clay and gravel for the building of Trinity Dam in northern California. More than 18,000 feet of conveyor belting are involved in the system. The belting is Longlife Nyfil high-tension construction. Reinforcing members of it are rayon-nylon materials, and the covers are special compounds of cold rubber. In addition to the main downhill conveyor system, the company also furnished the 48-inch wide belting for feeding the screening and crushing plant and the storage conveyors.

Cochrane Corp., Philadelphia, Pa., has announced that since the installation of its high-pressure condensate return system in an Indiana rubber plant, the efficiency of a 350-hp. boiler has been greatly increased. Lost time and defective cures have been practically eliminated owing to the temperature uniformity now achieved in the rubber company's 100 platen presses. High-temperature condensate return is said to save more than 25% of fuel costs. The greatest saving results from the uniformity of press temperatures, regardless of length of steam lines or distance from the boiler, the company reported.

Diamond Alkali Co., Cleveland, O., is producing on a pilot-plant basis at its organic facilities in Painesville, O., three more chlorinated xylene compounds. The new products are terephthaloyl chloride, a derivative of γ,γ'-hexachloro-p-xylene which the company has been producing, γ,γ'-hexachloro-m-xylene, and its derivative isophthaloyl chloride. These acid chlorides have possible use as raw materials for interfacial polycondensation for preparation of polyamides and polyphenylesters. The γ,γ'-hexachloro-m-xylene hydrolyzes to isophthalic acid, forms isophthalic esters through alcoholysis, and can be halogenated in the ring.

The Goodyear Tire & Rubber Co., Akron, O., has developed a high-activity antiozonant-antioxidant chemical which is being used in the rubber compounds in the manufacture of all lines of tires and tread rubber for recapping tires. This chemical is said to give superior resistance to sidewall checking and cracking as well as to protect against heat and fatigue.

Alco Oil & Chemical Corp., Philadelphia, Pa., and **Southern Latex Corp.,** Madison, N. J., Austell, Ga., and Concord, N. C., have announced that the latter will sell, distribute, and provide technical service on Alco's thickeners and chemicals in the southeastern states. Southern will maintain adequate stocks of Alco's Alcogum thickeners, Vulcacure accelerators and antioxidants, and warp sizes at its Austell, Ga.; Concord, N. C.; and Dalton, Ga., branches.

Seiberling Rubber Co., Akron, O., has developed and is manufacturing new laminated materials for use as window shades and wall panels for the Boeing 707, one of the first U. S. jetliners. The window shades are a plastics product bonded to foil. The interior wall panels are made of decorative materials inlaid between polyester films and vinyl sheeting. Among the decorative materials used are fabrics, gold threads, glass chips, and aluminum laminates.

Chemore Corp., New York, N. Y., general representative in the United States and Canada for Montecatini Soc. Gen., Milan, Italy, recently reported that prices on Moplen polypropylenes were reduced 7¢ per pound, effective September 2. Price per pound for natural resin is now 49¢ in truckload quantities; standard colors are 58¢ per pound. Prices for less-than-truckload quantities have been reduced 7¢ per pound down the line. Moplen is currently available in pellet form for injection molding and extrusion. Specially formulated compounds can be obtained for other applications.

Shell Chemical Corp., Torrance, Calif., recently added S-1009 and S-1605 to its line of synthetic rubber polymers. S-1009 is a hot, non-pigmented, styrene-butadiene copolymer cross-linked with divinyl benzene. S-1605 is a masterbatch of 50 parts of fast-extruding furnace black in 100 parts of S-1502 type polymer. Technical bulletins SC-58-79 and SC-58-78, describing S-1009 and S-1605, respectively, are available from the company.

Dawbarn Brothers, Inc., Waynesboro, Va., manufacturer of plastic monofilaments, has announced that N. H. Sherman is in charge of new product development, and M. Jack Rinehart, Jr., is a sales representative at its recently opened sales office in Montclair, N. J.

Ripple Sole Corp., Detroit, Mich., has announced that the Government of Japan has granted a registration for the trade mark Ripple Sole. The registration rights are effective as of July 9 and run for a period of 20 years. The designated goods covered are rubber soles. The Ripple Sole is being made in the United States exclusively by Beebe Rubber Co., Nashua, N. H.

Parker Seal Co., division of Parker-Hannifin Corp., Cleveland, O., has developed a high-strength silicone compound, designated 75-148, for O-rings and other molded seals which is said to be suitable for extreme low-temperature use in the range of minus 100° F. in engine or weather-resistance oil. The company also indicates that the material is usable for limited periods at temperatures up to 500° F. and in high aniline oils to 350° F. It meets requirements such as enumerated in specification SAE-AMS 3335.

The Goodyear Tire & Rubber Co., Akron, O., is supplying 22,000 feet of conveyor belting for use in constructing a diversion channel on the Niagara River near the American Falls. The channel will supply water to a hydroelectric power plant at Lewiston, N. Y. The conveyor belting will be used for materials handling at an aggregate preparation plant and a concrete batch plant.

The Berco Latex Corp., formerly of Caldwell, N. J., has moved its plant, laboratories, and offices to 1250 Shames Dr., Westbury, L. I., N. Y. The new building and plant facilities were specifically designed for the firm's operations and for providing more efficient service to customers. Berco's products include latex compounds for latex thread, rug backings, upholstery backing, latex dolls and toys, and other applications. The company also manufactures plastisols and plastigels for toys, wire coating, and textile coatings.

Neville Chemical Co., Pittsburgh, Pa., has announced that Indene (C_9H_{10}) is now available for the first time. Neville, a leading manufacturer of coumarone-indene and petroleum resins and other chemicals, now is producing Indene in pilot-plant quantities for commercial research applications. It offers Indene, a new reactive monomer and basic chemical, to the chemical industry as a building block molecule for the synthesis of a wide range of products. The high-purity Indene (98%) is an almost water white, non-polar liquid with a boiling point of 182° C., a freezing point of —3.5° C., and a specific gravity of .993.

United States Rubber Co.'s Naugatuck Chemical Division, Naugatuck, Conn., is starting commercial production of what is said to be the highest heat-resistant polyester plastic yet developed. The new plastic, Vibrin 136A, will withstand a sustained temperature of 500° F. and a peak load of 1,000° F. for short periods of time, it was recently reported at a symposium on structural plastics jointly sponsored by the Wright Air Development Center and the University of Dayton in the Hotel Miami, Dayton, O. The new plastic is said to have approximately twice the heat resistance of previous polyester plastic resins, which are used primarily in reinforced plastic applications. Also, its radar transparency is reported to be approximately ten times better than that of conventional polyesters, enhancing its use in such applications as radome material in jet bombing planes.

The General Tire & Rubber Co., Akron, O., recently added a new flexible permanent magnetic material to its list of industrial manufacturing products. Under terms of a license with the inventor, Max Baermann, of West Cologne, Germany, General Tire becomes the sole producer in the Western Hemisphere for the new, ingenious product with unlimited applications in the industrial, commercial, and household manufacturing fields. Special magnetizing equipment has already been installed by General Tires' industrial products division, which operates three manufacturing plants in Indiana, with headquarters at Wabash. Patent applications for the Baermann materials have been filed in the United States.

The Goodyear Tire & Rubber Co.'s industrial products division, Akron, O., has announced price increases on some of its products. Rubber hose, belting, molded and extruded rubber and plastic products, and other industrial rubber items were given individual cost studies, and prices advanced only where absolutely necessary. Price increases vary from 3% on most hose products to 5% on molded rubber products containing fabricated metal components.

Borden Chemical Co., New York, N. Y., has announced a new water-based, non-flammable contact cement, designated "Elmer's Contact Cement Non-Flammable." The new product, developed to replace the company's solvent-based non-flammable contact cement, is designed for bonding plastic laminates, dissimilar materials, and installing plywood wall panels. The product is said to provide an exceptionally strong bond, yet can be washed off hands and equipment with warm, soapy water. It is non-toxic and does not produce dangerous fumes. Compared with solvent-based contact cements, the economical new cement gives twice as much coverage when applied by brush, roller, or spray, the company says.

Thermoid Co., Trenton, N. J., has developed a new high heat resisting (HHR) compound now being used in the manufacture of all Thermoid hydraulic brake cylinder cups. The new compound is said to assure maximum durability under the high operating temperatures present in modern braking systems.

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has disclosed that its Viton, a fluorine-based elastomer, has been adapted to a recently developed wiring fastener, making it useful for missiles and high-speed aircraft. Viton is required for the clip material for use with temperatures as high as 300° F., accompanied by the presence of lubricants, aromatic fuels, hydraulic fluids, and other strong oxidizing agents. Du Pont supplies the Viton synthetic rubber and the Zytel nylon resin from which the cable fastener is fabricated. The fastening system, marketed as Insuloid Cradle Clip system, is manufactured in both the United States and Canada and sold by Electrovert, Inc., New York, N. Y.

International B. F. Goodrich Co., Akron, O., recently announced the organization of B. F. Goodrich do Brasil and plans to build a plant in Campinas, Brazil. Construction of the plant, which will manufacture tires, tubes, plastics, and industrial rubber products for the automotive industry and the replacement market, will be started immediately, with first production anticipated late in 1959. Goodrich is now associated with Latin American rubber manufacturing and chemical companies in Colombia, Cuba, Brazil, Mexico, and Peru.

The Ohio-Apex Division, formerly in Nitro, W. Va., has become a part of the chemicals and plastics division, Food Machinery & Chemical Corp., 161 E. 42nd St., New York 17, N. Y. All correspondence should be sent to this new address, even though production remains at Nitro, W. Va.

Eastern States & Chemical Corp., Houston, Tex., has opened another terminal, in Savannah, Ga. Other terminals are in Chicago, Ill.; East Liverpool, O.; Madison, Ind.; Brownsville, Tex.; Carteret, N. J.; and Los Angeles, Calif. Custom designed barges and other specialized shipping facilities are used exclusively for solvent delivery to the various terminals. A complete line of the firm's Espesol-brand petroleum-base aliphatic and aromatic solvents is carried by each terminal.

Martin Rubber Co., Inc., Long Branch, N. J., has taken over the business of Standard Rubber Co., Philadelphia, Pa. effective September 2. Mrs. Mary Woods, who operated Standard Rubber for many years, died suddenly in late August, and arrangements have been made with Robert Woods to service all Standard Rubber accounts direct from the factory at Long Branch.

The Military Clothing & Textile Supply Agency, Philadelphia Quartermaster Depot, U. S. Army, Philadelphia, Pa., plans to procure in the near future approximately 7,616 pairs of gloves, toxicological agents protective, synthetic rubber and nylon film, gauntlet style. Deliveries will be scheduled from February-May, 1959. This advance announcement, P-59-E-112, is furnished to assist interested suppliers in their planning for participation in this procurement. Specifications and all pertinent applicable conditions will be contained in the forthcoming invitation from the Agency.

Daystrom, Inc., Murray Hill, N. J. electronics manufacturer, has acquired the business and assets of Industrial Gauges Corp., West Englewood, N. J., and the related patents owned by Charles B. Zimmer, president. Industrial Gauges is a pioneer and major manufacturer of non-contact gages, advanced instruments which use infrared, X-rays, or visible light to determine thickness, density, width, diameter or other characteristics of materials. These sensing and analytical devices are used in a wide range of industries including steel and non-ferrous metals, chemical, petroleum, electrical-electronic, rubber, and food.

B. F. Goodrich Australia, Ltd., a new organization, recently was announced by International B. F. Goodrich Co., a division of The B. F. Goodrich Co., Akron, O. Associated with Goodrich in the new company will be Ampol Petroleum, Ltd., and other Australian investors. Construction of a plant near Melbourne, Victoria, for the manufacture of tires and other products, will be started before January. Goodrich is presently associated with 17 companies in the rubber products and chemical businesses located throughout the world.

Diamond Alkali Co., Cleveland, O., producer of industrial and agricultural chemicals, plans to build a multi-million-dollar, campus-style research center a few miles south of Painsville, O. It will be located in Concord Township on an 800-acre tract bounded on the north by the North-South Throughway (Ohio Route 1) and on the east by relocated State Route 44. The project marks an integral part of a long-range research and development expansion program by Diamond to meet the company's anticipated future growth needs and to maintain its competitive position in the chemical industry.

B. F. Goodrich Tire Co., Akron, O., is now marketing an original equipment six-volt replacement battery for the Volkswagen, Austin Healey, Jaguar, MG, and Opel. Called "Pow-R-Pak," the name Goodrich gives its standard line of replacement batteries, the new size gives a replacement battery for most foreign cars sold in the United States.

Atlas Powder Co., Wilmington, Del., has announced a new low-cost polyether that is expected to replace the more costly polyesters in rigid polyurethane foam manufacture. These rigid foamed-plastic materials are used as a strong filler in the new sandwich-type construction in domestic and commercial refrigerators and freezers, refrigerated cars and trucks, boats, building panels, and elsewhere. Atlas's polyether is a derivative of plentiful low-cost sorbitol, and it has six hydroxyl groups available for cross-linking. Since rigid polyurethane foams can use up to 60% by weight of this new polyether, manufacturing costs can be reduced, and the market for rigid foams, therefore, should be significantly increased. This new polyether stems from Atlas's basic position in sorbitol.

Hummel Chemical Co., Inc., New York, N. Y., is now offering a technical grade of calcium nitrate, a material used by the rubber industry as a coagulant for latex compounding. A technical data sheet and further information are available from the company.

Petroleum Chemicals, Inc., New Orleans, La., in a step to expand its current research activities, is organizing a development department comprising three divisions—research, projects analysis, and market analysis. The research division will work toward the development of new chemicals based on the four basic petrochemicals presently manufactured by P. C. I.—butadiene, ethylene, propylene, and ammonia. The new chemicals which the firm will seek to develop are intermediates used in the production of synthetic fibers, plastics, and elastomers.

The Erie Foundry Co., Erie, Pa., has developed what is said to be the first fully automated forging press. This 2,500-ton press is designed for high-volume forging of parts such as connecting rods, gear blanks, automotive and tractor valves, stem pinions, ring gears, track links, and wheel hubs. It has been tested with a set of dies owned by a major farm machinery producer for production of crawler track links. Erie claims the press will produce from two to three times the number of forgings that the most productive hand-operated presses have forged, per unit of time. Erie supplies hydraulic presses for a variety of uses among which are metal forming, metal forging, powdered metal molding, rubber and plastic molding, extrusion, and many other purposes.

World Patents Monitor, Rye, N. Y., in a new service will comprehensively survey new polymerization technology, reported in its patent literature. Subscribers to this service will receive a monthly listing of titles, patentees or assignees, and number of patents currently issued in the field of polymerization processes and products by nine countries. Coverage includes Australia, Belgium, Canada, France, Germany (patents and patent applications), Great Britain, Italy, Switzerland, and the United States. All titles are reported in English. Reference will be made to approximately 6,000 patents a year. Annual cost of this service is $65.00.

The B. F. Goodrich Tire Co., Akron, O., has developed, in cooperation with the X-ray department of General Electric Co., a mobile X-ray unit for diagnosing tires and determining production defects, if any, in less than 60 seconds. Ply separation, air pockets under plies or the tread, and other defects may be shown to the tire builder immediately, and corrective action taken. The company is also exploring the possibilities of using the new mobile unit for studying other rubber products it makes.

The Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J., is now processing Du Pont's Teflon to make hose up to three inches in diameter. Flexible Teflon-lined hose can now be obtained to handle safely larger volumes of chemicals, acids, and other active or caking solutions. Sold under the Flexon name, this hose can be made with Manhattan's exclusive Hydro-lok flange, which avoids the use of metal couplings. Teflon, able to stand temperatures up to 325° F., withstands all known chemicals, except fluorine gas, chlorine, trifluoride, and molten alkali metals, it is claimed. It can be sterilized to permit handling milk and other food products and is well suited for handling caking solutions.

Borden Chemical Co., New York, N. Y., has announced the addition of a ⅝-inch model to its 1959 line of Resinite vinyl garden hoses and sprinklers to meet the growing demand for a larger hose in the economy price field. The firm also reports that two of its hose models have been changed. They are "Flex-Tred," a high-grade, reinforced hose, formerly known as "Duro-Tred," and "Garden Pride," a high-quality economy hose formerly known as "Realite." The "Flex-Tred," which will be manufactured in a richer, darker green color and with a new braid pattern that increases flexibility, is to be available in the same lengths and sizes as the "Gold Stripe," a nylon-reinforced hose. The sizes are 25-, 50-, and 75-foot lengths, with ½-, ⅝-, and ¾-inch inside diameters. "Garden Pride," available in both transparent and opaque models, will come in three different sizes. In the opaque, 7/16-inch hose will be offered in 25-and 50-foot lengths. The ½- and ⅝-inch diameters will come in 25-, 50-, and 75-foot lengths.

Stein, Hall & Co., Inc., New York, N. Y., recently announced that General Latex & Chemical Corp., Cambridge, Mass., has acquired a portion of its Long Island City, N. Y., latex compounding equipment, used to manufacture special rubber-based compounds for the carpet and casting industries. These compounds, previously offered for sale by Stein, Hall & Co., are now available at General Latex & Chemical Corp.'s plants in Cambridge; Dalton, Ga.; Ashland, O.; and Charlotte, N. C.

Rubber Manufacturers Association, Inc., Traffic Committee, New York, N. Y. has been advised by the New York Committee of Inward Far East Lines that ocean freight rates on natural rubber and latex shipped from the Far East were reduced $3.50 per ton, effective August 9. The rates were made effective by the Straits/New York Conference on August 9, and by the Delhi/New York Conference and the Java/New York Rate Agreement on August 13.

The Goodyear Tire & Rubber Co., Akron, O., has announced an 8% price cut on Vitafilm, a heavy-duty packaging material, effective September 20, resulting in a drop from 79 to 73¢ a pound. Additionally, a new freight policy on the product is concurrently effective, with all shipments to move f.o.b. Akron, freight prepaid. Combination of the new film price and freight policy means a cost reduction of up to 12% to the customer, it was reported.

Skinner Bros. Rubber Co. has announced that its new mailing address is Box 13556, Dallas 24, Tex.

NEWS about PEOPLE

James E. Shand has been named manager, chemical sales, and **John C. Esher,** assistant manager, for the new plastics and coal chemicals division, Allied Chemical Corp., New York, N. Y. Formerly assistant manager of chemical sales for Barrett Division, from which the new division was formed in July, Shand joined Allied in 1946 as a technical representative for Barrett's chemical sales department. He served successively as special representative and assistant sales manager and in 1956 was appointed assistant manager.

G. Verhaar has been appointed director of research of the Firestone Plantations Co., Liberia, West Africa. He succeeds **K. G. McIndoe,** who retired August 11. Dr. Verhaar joined the company in 1951 as research chemist and was appointed chief chemist in 1957.

Lawrence H. Bruce has been appointed sales manager of latices for the Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. He will be responsible for planning the sales activities of all basic latices produced and sold by the division. He was formerly assistant sales manager of colloidal products.

Lawrence H. Bruce

W. W. Seward has been elected vice president of General Latex & Chemical Corp. (of Georgia), Dalton, Ga. Seward, who retains his position as general manager, was named to his post at a recent meeting of the board of directors.

Joseph Gersbach, head of factory development, has been advanced to head the compounding and development of tread rubber and tire repair materials, Lee Rubber & Tire Corp., Conshohocken, Pa. Filling the factory development post vacated by Gerbach will be **Joseph Slater.** In a previous appointment **James Lloyd** was named manager of tire and tube compounding. **Edward Gabuzda** will be in charge of mechanical goods, chain-store items, and drug sundries development and compounding.

Merrill M. Smith has been assigned to a recently created post, vice president in charge of manufacturing for the Amtico vinyl and rubber flooring division of American Biltrite Rubber Co., Trenton, N. J. Announcement of this appointment was made by **Robert G. Marcus,** Amtico vice president and general manager. Smith served as plant manager at Amtico for the past three years and prior to that, as chief chemist for three years.

Merrill M. Smith

Roger E. Caffier has been named chemical sales representative for the Cleveland, O., area for the plastics and coal chemicals division, Allied Chemical Corp., New York, N. Y. He has been the company's representative in the Providence, R. I., area for the past two years. He replaces **Julian S. Pruitt,** who died recently after a short illness.

Malcolm B. VerNooy has been promoted to product manager in the new chemicals group of Union Carbide Chemical Co., division of Union Carbide Corp., New York, N. Y. In his new position Dr. VerNooy will direct the market development of Carbide's chemicals that are used in resin applications and will be responsible for the marketing of acrylates.

George Hackim, Jr.

John A. Kleinhaus has been named manager of manufacturing, **George Hackim, Jr.,** general sales manager, and **L. W. Reeves,** commercial manager, in the chemical division of The General Tire & Rubber Co., Akron, O. Kleinhaus will direct the activities of the three production facilities of the chemical division at Mogadore and Ashtabula, O., and Odessa, Tex., through the respective plant managers. Hackim will direct the work of product sales managers, sales development, and technical services. Reeves will serve in staff capacity to coordinate the marketing program of the division, including sales abroad.

Arthur C. Tharp has been appointed regional sales manager for the Midwest region of the mechanical goods division of United States Rubber Co., headquartering at the Chicago, Ill., branch. Since 1955 he was district sales manager in the San Francisco, Calif., office, and prior to that had held the same post in the Milwaukee, Wis., office. He has been with the company since 1936.

Mark M. Frimodig has been appointed manager of Michigan Chemical Corp.'s new magnesium oxide plant at Port St. Joe, Fla. He has been with the company since March, 1952. His outstanding accomplishments in process development, plant design, and plant operation in Rare Earths won for Frimodig the company's achievement award in 1957.

Theodore E. Smith has been appointed manager of sales training for the mechanical goods division of United States Rubber Co., headquartering at the company's plant in Passaic, N. J. He was formerly assistant commodity sales manager for power transmission products at the company's plant in Philadelphia, Pa.

W. H. Thorbecke

W. H. Thorbecke has been appointed manager of the International Division of Continental Carbon Co., New York, N. Y. In his new position, he will be responsible for the development and operation of the company's overseas business.

J. C. Welch, former buyer of retread equipment for Firestone Tire & Rubber Co., has been appointed general sales manager for Rawls Brothers Co., Inc., Lima, O. Rawls manufactures a complete line of equipment for tire retread shops.

James C. Donald has joined the organic chemicals sales force of the Dewey & Almy Chemical Division, W. R. Grace & Co., Cambridge, Mass. He will serve in a home office capacity, specializing in extending and developing markets for the firm's vinyl acetate polymer and copolymer emulsions; styrene-butadiene latices and resins; dispersing agents; and plasticizers.

Wilbur E. Combs is now manager of development for the mechanical goods division of United States Rubber Co., Passaic, N. J. He joined the company in 1945 and since has held a wide variety of executive positions. In 1952 he became sales manager for Gilmer products in Passaic, and early in 1953 he was assigned the position of merchandise manager at the same location. A year later he was appointed assistant manager of sales development at the company headquarters in New York, N. Y. He became sales promotion manager for the division at the Passaic plant in 1957 and early in 1958 was appointed manager of market research. In his new assignment he will retain his responsibilities in market research and will continue to headquarter at Passaic.

C. R. Simpson

C. R. Simpson has been appointed a technical sales representative for Harwick Standard Chemical Co., Akron, O. He was formerly associated with The B. F. Goodrich Co. Simpson, in his new position, will work out of Harwick's Akron office and will contact accounts in Ohio, western Pennsylvania, and West Virginia.

Patrick J. Dowd has been elected treasurer of Monsanto Chemical Co., St. Louis, Mo. Dowd, who had been director of administration for the company's overseas division, succeeds **Edward D. Toland, Jr.,** who has resigned.

Harold R. Elliot, controller of Wellington Sears Co., New York, N. Y., left the company August 31 under its retirement plan. Elliot, who joined Wellington Sears in 1921, has served in all the company's financial divisions and was appointed controller in 1941. He has also been a member of many organizations in his field.

Pach Bros., N. Y.

Wilbur E. Combs

L. L. Baseler has been appointed director of administration of the overseas division of Monsanto Chemical Co., St. Louis, Mo. He succeeds **Patrick J. Dowd,** who has been elected treasurer of the company. Baseler has been associate director of marketing for the overseas division since April, 1948.

Ferd Muller has been appointed northeastern district representative of C. A. Litzler Co., Inc., Cleveland, O., engineer and manufacturer of continuous web and strand process equipment for the synthetic fiber, rubber, plastics, and wire industries. Headquartering in Montclair, N. J., Muller will serve the New England states, New Jersey, Delaware, eastern New York, and eastern Pennsylvania, counseling manufacturers in process problems and application engineering of Litzler laboratory and production equipment.

Master Studio

Ferd Muller

News about People

Thomas D. Ramsey is now district sales manager in the Gastonia, N. C., area for the Naugatuck Chemical division, United States Rubber Co., New York, N. Y., and will be responsible for sales of all the division's products in the South Atlantic district as well as the production of the Gaston, N. C., Lotol Compounding plant. He will report to **G. L. Dennis,** manager of field sales. Ramsey, formerly a technical sales representative for the division in the Los Angeles area, will replace **Claude H. Allard,** assigned to a production post at Naugatuck, Conn.

Martin H. Gurley, Jr., has been appointed to the newly created position of new product analyst of the Vulcan Rubber Products division of Reeves Brothers, Inc., New York, N. Y. Gurly, who has assumed his new responsibilities at the company's Buena Vista, Va., plant, will be responsible for research and analytical work in connection with the development of new products and product applications of the division. Prior to joining the company, he was general manager of the textile division of The Thermoid Co., Trenton, N. J.

Kenneth J. Soule, manager of Manhattan Laboratories, recently retired in his fortieth year with the Manhattan Rubber Division of Raybestos Manhattan, Inc., Passaic, N. J. With Manhattan, he did extensive work on transmission and conveyor belt development and helped adapt new synthetics and other materials into the company's processes. At his retirement he was manager of the Manhattan Laboratories which he helped to build and which are considered among the finest and complete in the industry. Soule is also a past chairman of the New York Rubber Group.

Robert O. Hayhurst has been appointed vice president in charge of manufacturing for the Biltrite division of American Biltrite Rubber Co, Chelsea, Mass., and Stoughton, Mass. This is a new position with the company, where Hayhurst has been factory manager for the past 10 years.

Hernando Tiongco Veloso, a native of Manila, P. I., is the first foreign student selected to receive financial assistance to study in an American college under a Goodyear Tire & Rubber Co. International Fellowship. The young Filipino is enrolled at Iowa State college, studying for his master's degree in biochemistry, as the first recipient of an international fellowship awarded to nationals of foreign countries in which Goodyear has manufacturing operations. The foreign fellowship awards are part of a comprehensive aid-to-education program administered by Goodyear Foundation, Inc., a nonprofit organization, formed in 1945.

James C. Richards, Jr.

James C. Richards, Jr., has been named vice president—sales of B. F. Goodrich Industrial Products Co., effective October 1. Richards, who joined the B. F. Goodrich Co. in 1934, has been vice president-sales, B. F. Goodrich Chemical Co., since January, 1952. In his new capacity he succeeds **R. V. Yohe,** now president and chief executive officer of B. F. Goodrich Canada.

F. L. Kilbourne, Jr., is now manager of Midwest Rubber Reclaiming Co.'s operations at Barberton, O., replacing **Ray R. Semler,** who passed away suddenly on July 9. From 1951-1958, Dr. Kilbourne was manager of research and development for the Connecticut Hard Rubber Co., and prior to that time he was with the research department of Firestone Tire & Rubber Co., having been chief chemist of the Xylos Reclaiming Division from 1941 to 1951. He has been associated with Midwest in the capacity of technical consultant since January, 1958.

Linwood A. Walters, succeeding **Gerald H. Mains,** who retired recently, has been named director of research and development for National Vulcanized Fibre Co., Wilmington, Del. He also becomes a member of the company's operating board.

George I. Rounds has been named vice president in charge of marketing for Industrial Rayon Corp., Cleveland, O. He succeeds **M. P. Epstein,** who relinquished his executive duties September 1 as a step in keeping with his planned decision to retire at the year end. Epstein will serve the company in a consulting capacity. Rounds, in his new position, will have his headquarters in the company's general offices in Cleveland and will be responsible for all sales, market development, and sales service activities.

Howard M. Bartlett, Donald H. Sargent, Donald W. Simroth, and **Dodson C. Webster,** four recent chemical engineering graduates, have joined the development department of Union Carbide Chemicals Co., division of Union Carbide Corp. They will be stationed at the South Charleston, W. Va., plant.

Thomas R. McMannus has been appointed to the sales staff of Colonial Rubber Co., Ravenna, O., where he will handle general sales and assist in industrial rubber development. The company specializes in custom rubber and silicone rubber compounding and molding.

Harold J. Michel, general manager of the film division, was elected vice president of American Viscose Corp., Philadelphia, Pa., at a recent meeting of the board of directors. **Paul E. Hill,** director of manufacturing of the fibers division, was also elected a vice president.

R. E. Tigner has been appointed a special representative for the sale of paint latices in the Northeast for the Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. He will cover New England, New York, New Jersey, eastern Pennsylvania and Maryland. Products he will handle include vinyl acetate, butadiene styrene, acrylonitrile styrene, and other paint latices.

Eustace Lingle has been made vice president in charge of industrial sales and education for Oakite Products, Inc., New York, N. Y., manufacturer of industrial cleaning and metal treating compounds. Lingle, who joined Oakite in 1929, was elected to the board of directors in 1939 and named vice president in 1953. He has now been given additional responsibilities covering sales, sales planning, and technical education.

P. D. Austin has been appointed hose sales product manager at the Hewitt Rubber Division plant of Hewitt-Robins, Inc., Buffalo, N. Y. He succeeds **R. A. Gifford,** now district manager responsible for sales of the company's industrial rubber products in the Pittsburgh, Pa., area.

Abram W. Hatcher now is with the new products research department, Godfrey L. Cabot, Inc., Boston, Mass., as a patent attorney. He was a patent coordinator with the Redstone division of the Thiokol Chemical Corp., Huntsville, Ala., until he joined the Godfrey L. Cabot firm in September of this year.

Octo

AZODOX

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STORES IN HALF THE SPACE

HERE ARE OTHER IMPORTANT REASONS WHY AZODOX IS BEST FOR YOU

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AZODOX is a revolutionary new form of zinc oxide (de-aerated). With twice the density, half the bulk of conventional zinc oxides, AZODOX is the answer to your storage problem. AZODOX comes to you in an easy-to-handle small package, shaped to permit closely packed, unitized shipments. *And the perfect texture of the material remains unchanged.*

AZODOX is available in all grades of American process lead-free zinc oxide.

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News about People

Harley O. Allman, one of the pioneers in the Goodyear-Canada operations, retired August 25, as special assistant to the vice president of the New Toronto, Ont., Canada, plant, after 48 years of continuous service with the company. He began his career with the Goodyear Tire & Rubber Co. in Akron, O., in 1910 in the tread room and two years later became a product inspector. In 1913 he was made foreman in the tire section and six years later was advanced to general foreman. Allman was transferred to the New Toronto plant in 1922 as superintendent of Division "B" and in 1943 was promoted to plant manager. He served in that capacity until he was named as special assistant to the vice president of the Canada plant in 1957.

Eugene I. Owens, formerly district manager for the Pittsburgh, Pa., area, now is eastern division manager of Firestone Rubber & Latex Products Co., Fall River, Mass., making his headquarters at 28 West End Ave., New York, N. Y. He replaces **Stacy F. Wolfe,** who has joined the synthetic division of the parent organization, The Firestone Tire & Rubber Co., Akron, O. Owens will be responsible for the sales of Foamex foam rubber and Diatex rubber webbing in the eastern division, which includes the New England and North Central States. **James MacFarland,** formerly with Firestone's mechanical goods division in Hartford, Conn., has been named new district manager for the Pittsburgh area.

Johnstone S. Mackay has been advanced to manager-general research in the research and development department of Pittsburgh Coke & Chemical Co., Pittsburgh, Pa. Dr. Mackay joined the company in 1952 as supervisor—basic research and in 1955 was made supervisor-process research, the position he held prior to his promotion.

R. F. Brown, sales manager, recently announced four additions to the organic chemical sales department staff of Emery Industries, Cincinnati, O. **Robert S. Haley** has been appointed to the New York, N. Y., office; **J. Warren Sackett,** the Cleveland, O., office; **Walter R. Paris,** the Lowell, Mass., office; and **Robert H. Endres** has been assigned to a newly created territory with headquarters in Pittsburgh, Pa. Haley transfers to the organic chemical sales department from the Volcolene division, for which he served as eastern sales representative prior to its acquisition by Emery earlier this year. Sackett was general manager of Bay Rubber & Plastics, Inc., before joining Emery. Paris went to Emery from Godfrey L. Cabot, Inc., where he was New England sales representative. Endres was formerly associated with Standard Oil Co. (Indiana).

Robert V. Yohe

Ira G. Needles, with B. F. Goodrich Canada, Ltd., since 1925 and president since July, 1951, has been elected chairman of the board of directors. Concurrent with Needle's election as chairman, **Robert V. Yohe** was elected president and chief executive officer of B. F. Goodrich Canada, Ltd., Kitchener, Ont. Yohe, formerly vice president-sales of B. F. Goodrich Industrial Products Co., a B. F. Goodrich Co. division, has been with the company since 1931, having started as a research chemist in the company's laboratories.

Victor L. Erlich has been elected vice president and director of basic research and development of Reeves Brothers, Inc., New York, N. Y., one of the nation's leading textile manufacturers. Dr. Erlich, who has a doctor's degree in chemical engineering from the Institute of Technology, Vienna, Austria, joined Reeves in 1950 and later became director of research for the firm's plastics division. In recent years he has been taking an increasingly active part in the research and development of the firm's textile and industrial products operations. The firm's textile production includes cotton, cotton and synthetic blends, and all-synthetic blends, for the apparel trade and for many industrial products, including coated fabrics, plastics, tapes, and airplane fabrics.

Frederick T. Koyle, of Carl M. Loeb, Rhoades & Co., a vice president and a director of Commodity Exchange, Inc., president and director of Commodity Exchange Rubber Clearing Association, Inc., and chairman of the board of the Rubber Trade Association of New York, Inc., will serve as chairman of the rubber division of the fifty-third annual appeal of the Travelers Aid Society of New York. Announcement was made by William G. Rabe, co-chairman of the 1958 appeal.

William J. Fogarty has been named manager of labor relations of The Firestone Tire & Rubber Co., Akron, O. A native of Akron and a graduate of the University of Akron, Fogarty took over his duties September 2, succeeding **J. V. Cairns,** who was appointed director of industrial relations of the company last January. Succeeding Fogarty as manager of industrial relations of the company's Des Moines, Iowa, plant, is **W. E. Bray,** manager of industrial relations at Firestone Industrial Products Co., Noblesville, Ind., since 1948. Replacing Bray in that post is **Fred Becker,** formerly assistant manager of industrial relations at the company's Pottstown, Pa., plant.

James M. Rice has been named director of the Natural Rubber Bureau's laboratory, Washington, D. C. This laboratory is perhaps the country's largest specializing in the development of rubber and asphalt for road use. Rice is widely known in the highway research field. He succeeds **J. York Welborn,** who has returned to the Bureau of Public Roads.

John J. Berry, previously Chicago district manager, is now district manager for the Kansas City district for Union Carbide Chemicals Co., division of Union Carbide Corp., New York, N. Y. He has been with Carbide since April, 1940. **Melvel W. Duncan,** most recently Kansas City district manager, becomes district manager for the St. Louis, Mo., district. He was employed by Carbide in June, 1946. **Hugh E. Klein,** product manager in the new chemicals group, is the new district manager for the Chicago, Ill., district.

Westi Hansen, assistant district manager, industrial products division, Chicago, Ill.; **Julian H. Lipscomb,** store manager, Portsmouth, Va., and **Edgar W. Hein,** store manager, Aberdeen, S. D., were presented Paul W. and Florence B. Litchfield Awards of Merit as The Goodyear Tire & Rubber Co.'s "best domestic salesman" and "best store manager" in their respective fields for their achievements in selling during 1957. Hansen was named the best wholesale domestic salesman as a result of his showing in the Dayton, O., territory where he served from 1953 until November, 1957, when he assumed his current assignment. Lipscomb and Hein were judged the best large store and best small store managers, respectively.

George M. Seib, secretary of Oakite Products, Inc., New York, N. Y., has been appointed vice president of the company, which manufactures industrial cleaning and metal treatment compounds. **Erwin H. Steif,** who was Seib's assistant, has been promoted to the post of secretary.

OBITUARIES

Fred S. Weida

Fred S. Weida, 62, supervisor of staff purchasing for The Goodyear Tire & Rubber Co., and long associated with its Far East rubber plantations, died suddenly September 11 in company offices in Akron, O.

He started with Goodyear in 1916 as a safety inspector in its labor department, but was transferred to the crude rubber department as a dispatcher and inspector later the same year. He left the company in 1918 for military duty and was discharged, with the rank of lieutenant in the army, in 1919, when he rejoined Goodyear's crude rubber division.

Mr. Weida spent the next 23 years in the Far East, serving successively as office manager, financial agent, purchasing agent, and manager of Goodyear's Dolok Merangir and Wingfoot Estate rubber plantations in Sumatra.

The deceased returned to this country in 1942 and after a two-month assignment with the Rubber Reserve Corp. in Washington, D. C., was appointed assistant purchasing agent at Goodyear in Akron. He became supervisor of staff purchasing in 1946.

He attended Howe Military School and Kenyon College.

He leaves his wife, a son, and a daughter.

Hugh Bullock


Hugh Bullock

Hugh Bullock, who retired in 1955 as president of Tyer Rubber Co., Andover, Mass., but who retained his position on the board of directors, died in an Andover hospital on August 17, after a lengthy illness.

His long and successful career in the rubber industry began in 1898, when he found employment with the United States Rubber Co. in its Naugatuck Conn., plant. From 1900 to 1909 he worked for the Beacon Falls Rubber Shoe Co., Beacon Falls, Conn. Then in 1909 he went with Converse Rubber Shoe Co., Malden, Mass., where he remained until 1927, when he joined the Tyer company. He served as its president from 1935 to 1955.

In 1910, Mr. Bullock spent two months in Brazil and the Guianas investigating the possibility of a rubber concession for a Boston syndicate. He was a consultant in the Office of the Rubber Director of the War Production Board during World War II and again at the start of the Korean conflict. He was also a director of The Rubber Manufacturers Association, Inc., from 1946 until 1955.

Mr. Bullock also was active in community, educational, and church affairs in Andover.

The deceased was born in Kill Buck, N. Y., on June 23, 1880. He was educated in nearby grade schools, a high school in Toledo, O., and the Scott Manual Training School of Toledo.

He is survived by his wife, three daughters, three grandchildren, and eight great-grandchildren.

Julian S. Pruitt

Julian Sharpe Pruitt, since March, 1957, chemical sales representative in the Cleveland area for the plastics and coal chemicals division (formerly the Barrett division), Allied Chemical Corp., died on August 28 after a brief illness.

He started with the company as a sales trainee in April, 1952, and was advanced to junior salesman in February, 1953, and to salesman in January, 1954. Prior to his Cleveland assignment he covered the Detroit and New Jersey territories for Barrett.

The deceased, who was born on August 17, 1926, received a B.Ch.S. in chemical engineering in 1951 from North Carolina State College. He also served two years in the First Cavalry Division before entering college.

Mr. Pruitt was active in local paint, rubber, and plastics trade organizations and also belonged to the Chemical Salesmen's Club of Cleveland and the American Society of Chemical Engineers.

Funeral services and burial took place in Greenville, S. C., on September 2.

Surviving Mr. Pruitt are his widow, a daughter, his parents, a brother, and a sister.

John A. Liljegren

John A. Liljegren, who retired as technical director of Pioneer Rubber Mills, Pittsburg, Calif., in October, 1954, after 34 years with the company, died on August 30 in Pittsburg.

Prior to his Pioneer association he had been employed by R. W. Hunt Co., San Francisco, Calif.

Mr. Liljegren was born in Moingona, Iowa, 78 years ago. He was graduated from Drake University.

He was an honorary member of the Northern California Rubber Group, Inc., a past president of the Pittsburg Rotary Club, and a member of the Division of Rubber Chemistry, American Chemical Society, Pittsburg Masonic Lodge No. 429, Pittsburg Chapter of the Eastern Star, and the St. David Episcopal Church.

Survivors include the widow and a son.

Statement of RUBBER WORLD

Statement required by the Act of August 24, 1912, as amended by the Acts of March 3, 1933, and July 2, 1946, (Title 39, United States Code, Section 233) showing the ownership, management, and circulation of RUBBER WORLD, published monthly at Philadelphia, Pa., for October, 1958.

1. The names and addresses of the publisher, editor, managing editor, and business manager are: publisher, B. Brittain Wilson, 386 Fourth Ave., New York 16, N. Y.; editor, Robert G. Seaman, 386 Fourth Ave., New York 16, N. Y.; managing editor, S. R. Hague, 386 Fourth Ave., New York 16, N. Y.; business manager, Ralph L. Wilson, 386 Fourth Ave., New York 16, N. Y.

2. The owner is: Bill Brothers Publishing Corp., Estate of Raymond Bill, Estate of Edward Lyman Bill, all at 386 Fourth Ave., New York 16, N. Y.

3. The known bondholders, mortgagees, and other security holders owning or holding 1% or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

B. BRITTAIN WILSON
Publisher

Sworn to and subscribed before me this 15th day of September, 1958.

[Seal] HELEN M. VERLIN
Notary Public in the State of New York. No. 31-9460500. Qualified in New York County.
(Commission expires March 30, 1960)

NEWS from ABROAD

France

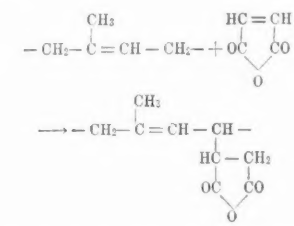
Maleic Anhydride-NR Products Show Promise

Investigations of the reaction of maleic anhydride and natural rubber, as conducted under the usual experimental conditions, have led only to derivatives which, as a result of secondary scission, cyclization, and cross-linking reactions, show considerable deterioration of the characteristic physical properties of natural rubber, particularly its high elasticity. It has already been noted, however, that under certain conditions these harmful effects can to some extent be avoided.

In "Modification of Rubber by Reaction with Maleic Anhydride," presented at a meeting of the Academy of Sciences, Paris, February 24, 1958, J. Le Bras C. Pinazzi and G. Milbert described their own tests.

They studied the effects of maleic anhydride in the proportions of 25-400% by weight on the rubber. The reactions were carried out at 180° C. during 30-180 minutes in sealed tubes, under deoxygenated nitrogen vacuum in toluene solution and in the presence of antioxidants (2,6-di-tert-butyl 4-methyl-phenol and 6-phenyl 2,2,4-trimethyl 1,2-dihydroquinoline) to prevent cross-linking reactions. The reaction products were precipitated, washed in acetone or ethanol, redissolved in benzene, and reprecipitated to eliminate all free aldehyde and antioxidant, and then finally dried under high vacuum until all traces of solvent had disappeared.

The differences in the proportions of gel rubber determined in the presence and absence of the antioxidants permitted the conclusion that the products thus obtained were substantially free from cross-linkages, and the formula for the linear molecule was assumed to be:



On the basis of the above theoretical formula and analytical data, it was calculated that a sample prepared with 50% anhydride added, and another with 400% anhydride added, contained respectively 5.5 and 22% combined anhydride, and that there were 4 and 20 succinicanhydride groups, respectively, present per 100 isoprene links.

Unlike the unmodified rubber hydrocarbon, the succinicanhydride derivative resulting from the reaction with 400% maleic anhydride is completely soluble in methylethylketone or butyl acetate and does not dissolve in hexane. Furthermore, it can be vulcanized simply by the action of a metallic oxide such as zinc or magnesium oxide, as well as by diols, diamines, or diisocyanates; whereas unmodified rubber subjected to the same treatment gives no evidence of vulcanization.

The yield of the reaction, expressed as combined anhydride in relation to anhydride used, is low. It is emphasized, however, that the purpose of these tests was merely to obtain a succinicanhydride rubber with high combined anhydride content, with a minimum of cross-linkages, so as to be able to establish the reality of the reaction and to demonstrate the resulting modifications in properties.

Table 1 gives the mechanical properties of some of the vulcanizates:

The control sample of rubber underwent the same treatment as the succinicanhydride rubbers, but in absence of the maleic anhydride.

The reaction was also carried out in internal mixers under a current of nitrogen, with the intention of obtaining products with limited amounts of fixed anhydride (1-4%), just enough to cause important changes in the properties of the elastomer. The products thus prepared could be vulcanized by the same agents already mentioned above, and the vulcanizates showed special technological properties which will be described in a future article.

These experiments, it is pointed out, have proved that it is possible to attach reaction groups on rubber which, without changing its high elasticity, confer high polarity capable of endowing the vulcanizates with new characteristics.

TABLE 1

	% Combined Anhydride	Curing Agent	Modulus at 300% (Kg/Cm²)	Tensile Strength (Kg/Cm²)	Elongation at Break, %
Ordinary rubber	0	S accelerator	40	260	550
Control rubber	0	S accelerator	30	60	450
Succinicanhydride rubbers	5	S accelerator	160	180	350
	5	ZnO	85	400	640
	24	MgO	140	140	300

Polymer Corp. Rubbers Discussed

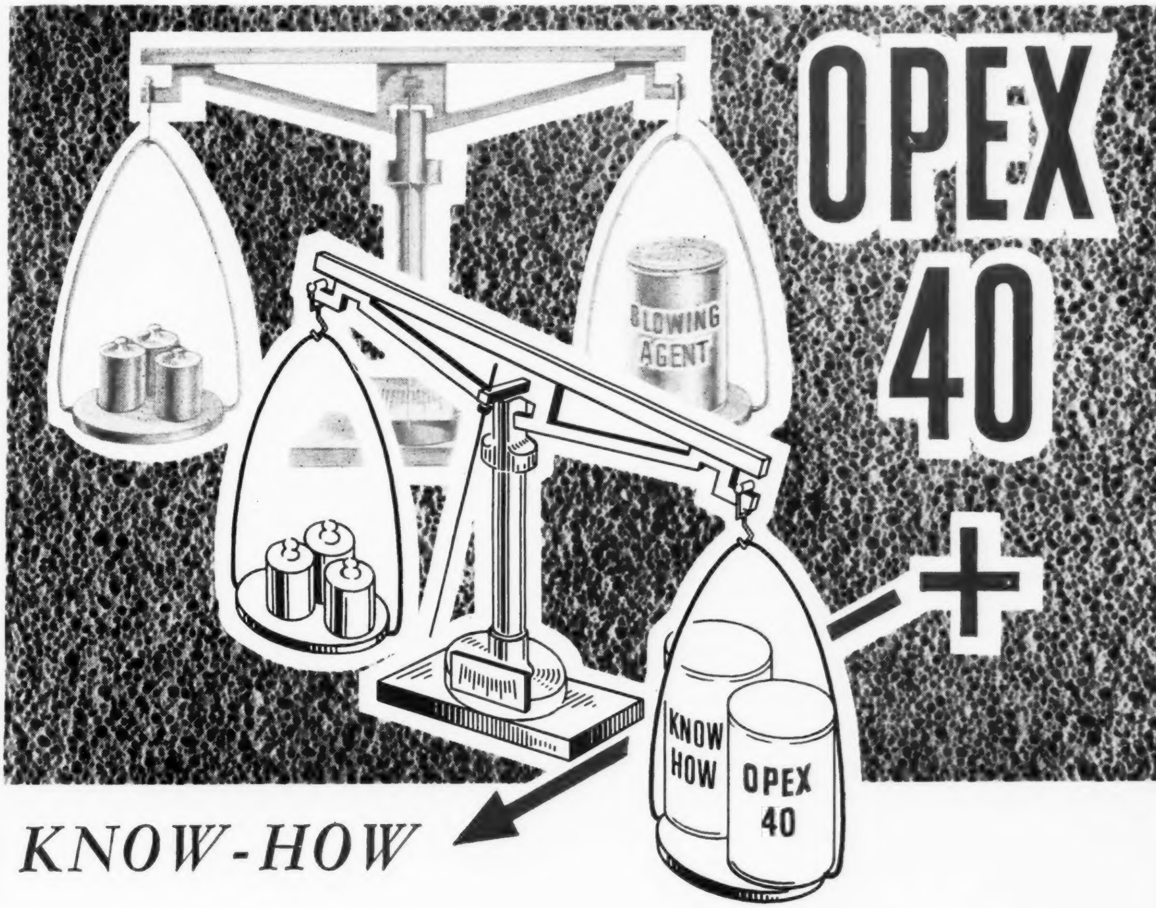
In collaboration with Polymer Corp., Ltd., the Association Française des Ingénieurs du Caoutchouc for the first time held a panel discussion-type meeting in Paris on May 13.

Representatives of Polymer Corp, including E. B. Storey, S. C. Kilbank, M. E. Blouin, and K. N. Pickard, assisted by G. Loosfelt, G. Cornil, and G. Giger, of the Société Française Polysar, answered a number of questions by members of the AFIC, referring to the use of Polysar S rubbers (hot SBR), Krylene (cold SBR), Krynol, (oil-extended SBR), Butyl, SS-250, Krynac (nitrile rubber), and latex, in the automobile for the following applications: (1) shock absorbers and vibration absorbers; (2) soft and spongy profiles (channeling and seals for windshields and doors); (3) flexible gasoline pipe, bonding of butyl and Krynac to rubber.

The large number of questions submitted—many more than could be dealt with in the two-hour session—and the large, highly interested audience, were evidence of the success of this new departure.

Carbon Black, Nitrile Rubber Manufacture

It is learned that the Société d'Electrochimie d'Ugine is to start the manufacture of carbon black at its factory at Villers-Saint-Sépulcre (Oise), using an original process developed by the Société des Produits Azotés, which has been producing the black in its own factory on an industrial scale for more



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than 18 months. The Villers-Saint-Sépulcre works will produce 5,000 tons annually to commence with, and the Société des Produits Azotés will undertake the selling. This new carbon black is understood to meet the standards of the rubber industry.

By an agreement with United States Rubber Co., Société Ugine has obtained exclusive license for the manufacture in France of different grades of nitrile rubber and of certain special latices for the paint, textile, and paper industries, as well as of Kralastic rubber-resin blends for the automobile industry, articles for the home and tubing.

Malaya

Trade Union Meeting Urges NR Price Scheme

Fluctuations in prices of primary products and their impact on Asian countries constituted the main topics of discussion at the fourth Asian regional conference of the International Confederation of Free Trade Unions (ICFTU), opened on August 30 in Malaya by Prime Minister, Tengku Abdul Rahman. Besides representatives from Singapore and Malaya, delegates were present from Japan, Formosa, Hong Kong, Indonesia, Ceylon, India, Pakistan, the Philippines, Thailand, and South Korea.

A paper presented reasons for price fluctuations and offered suggestions for price stabilization. On rubber, the point was made that demand of natural rubber could only be maintained by economic expansion in underdeveloped countries, with consequent increased use of the commodity.

As to supply of rubber, the smallholder introduced an element of uncertainty, since he did not usually take the long view, but was largely actuated by price, swamping the market to take all advantage of high prices. Smallholders were to a large extent responsible for the lag in the government's replanting program, and their production costs were also factors to be reckoned with.

It was recommended that smalholders be organized into cooperatives; the replanting schedules should be fulfilled within a specified time, and a rehabilitation fund raised by the imposition of a cess. Improved efficiency of labor was called for as one of the means for reducing production costs; closer cooperation aiming at better agreement between government policies and plans of rubber estate owners was urged, and, finally, the introduction of a trial scheme for organized state marketing of rubber was recommended.

The ICFTU secretary took the opportunity to send a memorandum to the Food & Agricultural Organization of the United Nations urging the arrangement of meetings of representatives of rubber producers and importers to discuss measures for stabilizing rubber prices in the world market. The meetings would lead to international agreements guaranteeing adequate minimum prices and fixed maximum prices, and providing for production control to insure that the prices are maintained. The beneficial effect on prices resulting from the operation of the international sugar agreement was held up as an example of what similar international agreements might do for natural rubber.

Australian Agreement Helps Rubber Industry

A trade agreement expected to benefit the Malayan rubber industry was arranged late in August between Malaya and Australia and is awaiting ratification. Australia's Prime Minister and Minister for Trade, John McEwen, and the Malaya Minister of Commerce & Industry, Tan Siew Sin, met in Kuala Lumpur to sign what the latter reportedly termed a "very balanced agreement," which is to run for three years.

Details have not yet been made public, but one gathers that Australia has undertaken to lift the import duty on Malayan rubber, a move which will put Malayan rubber in a better competitive position when synthetic rubber is produced in Australia.

That Australia will soon have her own synthetic rubber industry seems to be considered practically a certainty by the Malayan Minister. At a press conference he expressed this belief, adding that there was more than a likelihood that a number of oil companies were interested in establishing synthetic rubber plants in Australia and that very heavy investments were likely to be involved.

Australia buys two-thirds of her rubber requirements from Malaya. In 1956 these purchases represented a value of $33,000,000 (Straits); last year the amount involved was $27,000,000 (Straits).

Replanting Increases Estate Rubber Output

The results of government and private replanting programs are becoming apparent in the increased output figures reported by individual companies as well as in the country's overall production statistics.

The chairman of Dindings Rubber Estates, Ltd. reported recently that for the first time in its history the company's output exceeded one million pounds. The 1,460-acre estate at Sitiawan yielded an average of 1,000 pounds per acre; by the end of this year the entire estate will have been replanted with high-grade material.

The 12½% increase in crop shown for the first seven months of 1958, as compared with the same period in 1957, is similarly ascribed to the effects of replanting, by the chairman of Central Perak Rubber Co., Ltd. The July crop was stated to have been the best since 1949. Central Perak has more than 2,000 acres of immature rubber also, and if this area yields at the rate to be expected from the modern material with which it is planted, the company should be able to count on an additional crop of 2,000,000 pounds a year, in the future.

Malayan estates as a whole produced 214,617 tons in the first seven months of 1958, an increase of 5% over last year's output. July production was 17% above that for the same month in the preceding year and was the highest output for any month since August in 1949.

July was also a good month for smallholder outputs, which showed an increase of 8.9%, but this rise could not offset declines in the earlier part of the year, so that their total for the seven months, at 150,719 tons, was down 3.9% against last year's figure. The total for estate and smallholder rubber for the seven months of 1958, at 365,336 tons, showed an increase of not quite 1%.

China's Purchases Of Malayan Rubber

August rubber shipments from Malaya jumped 21% to 100,487 tons, topping 100,000 tons for the first time since May, 1951, when the total was 103,629 tons. This increase brings Malaya's shipments for the first eight months of 1958 to 706,504 tons, a rise of nearly 12%. The higher figures for 1958 and especially for August are chiefly due to the increased buying by Red China for her own account and latterly also as agent for the East European satellite countries.

Up to the end of July the East European countries had obtained about 43,000 tons of rubber by direct purchase from Malaya. According to a leading rubber dealer quoted by the *Straits Times*, the satellite countries cannot continue direct dealing with Malaya for lack of Sterling. The China Import & Export Corp., pays for the rubber—No. 1, 2, and 3 grades—in Malayan dollars, through letters of credit.

Some curiosity is expressed as to the reason why the East European countries are not buying in London, where the price is lower than in Singapore.


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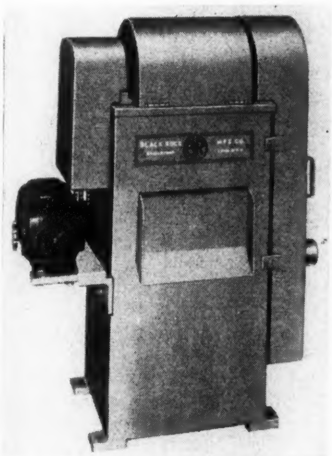
NEW EQUIPMENT

Rubber Band Cutter



Model RBC Cutter

The Black Rock rubber band cutter, a machine which is claimed to cut infinitely variable rubber band widths without the necessity of having a special pair of gears for each width cut, is now being built and marketed by the Black Rock Mfg. Co., Bridgeport, Conn.

Known as the Model RBC, the machine is equipped with a unit which can precisely control individual width cuts. The machine is completely self-contained, and the unit eliminates the regearing problems encountered when various width cuts must be made on a single rubber band cutter. Changes in band widths can be made while the machine is in operation.

Equipped with three revolving knives and one stationary knife, the RBC is said to cut rubber band widths with remarkable accuracy from 1/16-inch to one inch while making from 600 to 1,800 cuts per minute. Designed for heavy-duty service, the machine easily handles rubber stock thicknesses to 5/16-inch.

Power is supplied by a 2 hp., 900-rpm. motor which turns up 200 to 600 cutting rpm. and operates on 220/440-volt, 60-cycle, three-phase ac.

Machine specifications include: knife width, 13 inches; machine height, 48 inches; machine length, 26 inches; machine width, 42 inches; and feed table, 39¾ inches from floor.

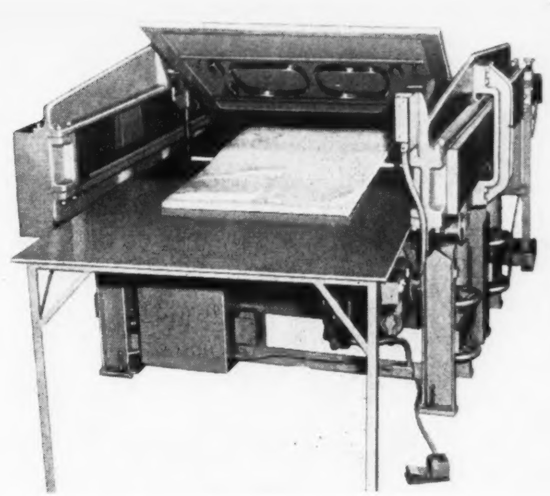
The RBC can be adapted to special applications such as dicing uncured stock by the addition of a slitter unit, and feeds up to three inches can be obtained by special gearing.

For literature and prices write the manufacturer.

Femco's Die Handling Mechanism

A new die handling mechanism said to widen potential use of roller die cutters made by Falls Engineering & Machine Co., Cuyahoga Falls, O., has been announced by the company. The mechanism reportedly works successfully in die cutting such materials as four-inch polyether foam, foam rubber, closed- and open-cell sponge rubber, vinyl fabrics, cork composition, gaskets, Fiberglas, rough cut vinyl floor tile, high-density soling, and uncured rubber stock. Accurate cuts with true vertical edges have been produced.

In operation, an operator can now die cut materials any of three ways on a Femco heavy-duty roller die cutter. First, the standard method may be used with the dies on the bed of the machine, stock on top of the dies, and the roller passing over the stock and making the cut. A second way, made possible by the new mechanism, is to mount the dies in a steel frame vertically above the bed area, with the stock on the bed of the machine. The steel frame lowers automatically until it rests on top of the material, precompressing it, and the roller moves over the back of the frame and dies.



Femco's die handling mechanism

The steel frame which holds the dies raises four to 12 inches above the bed for processing roll stocks. At the extreme upward position it tilts and hinges open 30 inches from the bed area, which makes it easy to load or unload slab stock. Since the bed area is clear of dies, roll stock or other thick sheets may be easily advanced across the area for fast production cutting. A complete cutting cycle has been timed at 10 seconds in test operations.

When the third method is used, the dies are again placed on the bed of the machine. A ¾-inch plywood board faced with stainless steel is mounted in the frame which is positioned above the bed area. Stock is then placed over the dies; the plywood board is lowered, and the roller passes over the board, pressing it against the stock and making the cut. This method, according to the company, will lengthen the life of the dies.

The new die handling mechanism may be attached to three models of Femco heavy-duty roller die cutters now in use. They are models 48 by 42 inches, 60 by 48 inches, and 72 by 66 inches. For further information write the manufacturer.

Taylortest I Test Set

A new type of portable instrument, known as the Taylortest I, is now available from Taylor Instrument Cos., Rochester, N. Y., for checking, installing, or servicing the Taylor Transet potentiometer transmitters and allied equipment. The instrument is a combined precision signal source, full potentiometer, and milliammeter. It is particularly useful for calibrating all forms of amplifiers or servomechanisms which convert small signal voltages into proportional electrical currents for control or transmission use. The instrument, being completely self-contained, provides all facilities, accuracy, and convenience requisite to testing in the field or laboratory, according to the manufacturer.

There are two-millivolt ranges on the Taylortest I: 0-60 absolute MV, and also 95 up to 105 MV. These calibrations make the unit useful for measuring the outputs of thermocouples, thermal convertors, radiation receivers, shunts, and other types of primary measuring elements.

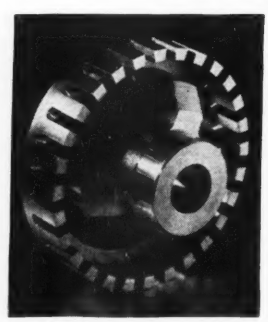
A signal-measure switch is a feature which enables the instrument to be used as a source of known millivolt signals. When this switch is on the signal position, known millivolt values appear at the instrument terminals. For checking amplifier output currents the instrument is equipped with an indicating meter which is scaled from 0 to 5.0 milliamperes, direct current. The direct meter indications are useful for ordinary testing and calibrating. Where greater precision is required, an individual correction card is furnished with each meter.

Overall dimensions of the instrument are 5⅜ by 8 by 5 9/16

Taylortest I Instrument

inches. Weight is 5½ pounds. Other features include guarded output circuit, and mercury battery power. For complete electrical and mechanical specifications, write the Taylor Instrument Cos.

New Polytron Mixers



115 Polytron mixing impeller

A new mechanical high-frequency wet-milling and mixing device, available in four models, is being manufactured by the Bronwill division of Will Corp., Rochester, N. Y. Designed as a multi-purpose homogenizer-disperser, the Willems Polytron has laboratory and production application in many diversified fields.

Feature of the Polytron is its milling head, a precision ring-within-a-ring combination of shearing blades. The inner ring of shearing blades (see illustration), revolving at speeds up to 18,500 rpm on a central shaft, is encased within a stationary ring of shearing blades that is attached to a stationary outer tubular shaft.

The inner ring, rotating at high speeds, provides a strong pumping action that circulates the material being processed. Shear, impact, cavitation, and pressure changes also take place that further reduce particles in size. Diverse and effective action is provided by the combination of ring sizes, numbers of cutting edges, clearance between rings, and the peripheral speed of the rotor.

The company cites the high-speed production possibilities of the Polytron and claims an efficient reduction of materials to particles a few microns and sub-micron in size. Processing advantages are said to include thorough processing because of complete circulating pumping action, self-cleaning, and simultaneous mixing and homogenizing.

The four Polytron models, powered by 1½, 3, 30, and 60 hp.

(*Continued on page 122*)

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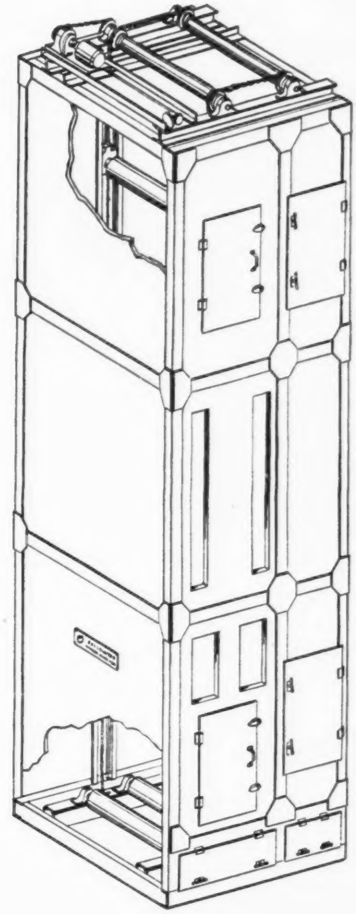

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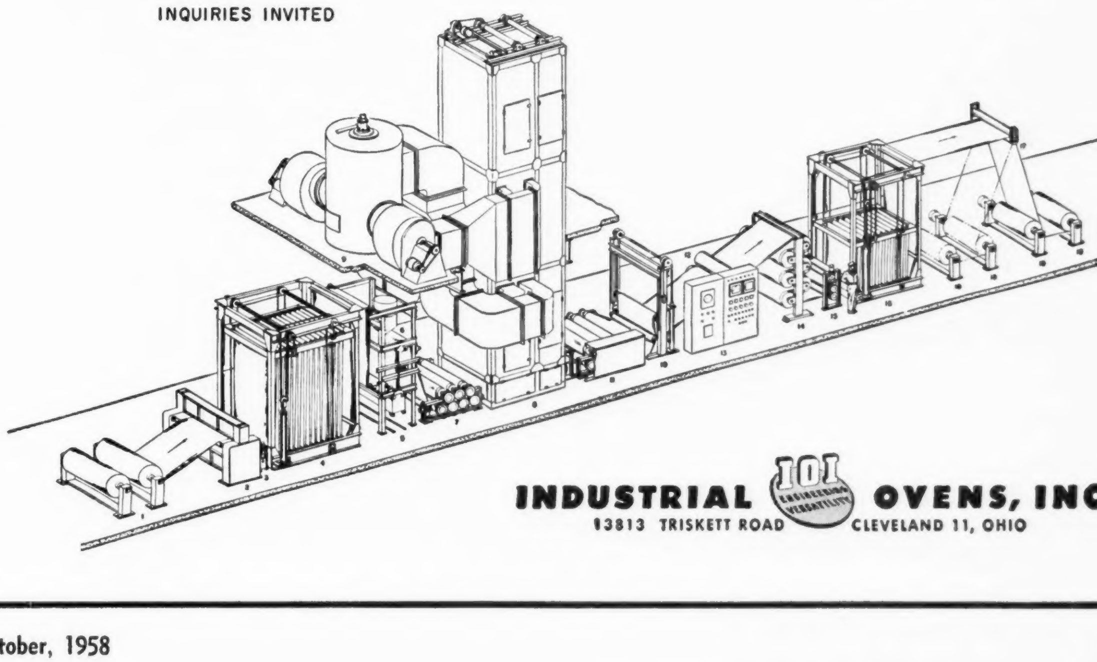

INDUSTRIAL OVENS, INC.
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NEW MATERIALS

Conac S Accelerator

A new form of sulfenamide-type accelerator, designated Conac S, has been announced by the elastomer chemicals department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. The value of sulfenamide accelerators for delayed-action curing of rubber compounds has been proved by past experience.

The standard sulfenamide accelerator of the industry is N-cyclohexyl-2-benzothiazole sulfenamide, which has been shown to have an outstanding combination of performance and economy. Conac S is a clean, easily dispersed powder form of this material. It may be used directly, according to the manufacturer, in any formulation calling for a sulfenamide, without the customary laboratory evaluation.

Some typical physical properties of Conac S follow:

Physical form	powder
Color	cream
Specific gravity	1.27
Storage stability	good
Melting range	95–100° C. (200–212° F.)
Solubility	soluble in benzene and acetone; insoluble in gasoline and water
Health hazards	none

A technical bulletin, Report BL-341, describing Conac S, is available from the company.

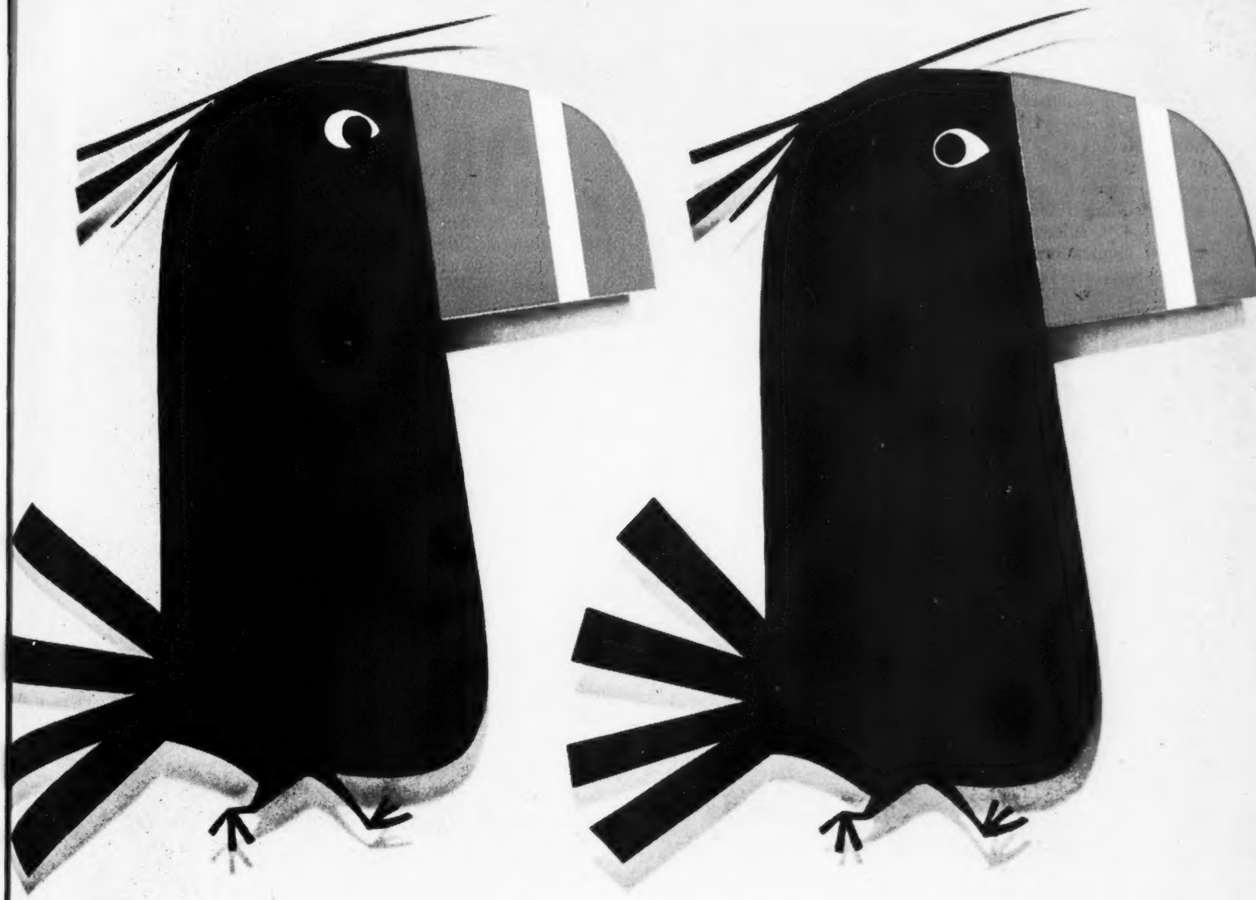
New Poly-Dispersions

Recent additions to its line of Poly-Dispersions, slab-form dispersions of various rubber chemicals in polyisobutylene binders, have been announced by Wyrough & Loser, Trenton, N. J. These materials have high active ingredient concentration. The polyisobutylene binder is said to be compatible with all commercial elastomers, is a non-vulcanizate, has no effect upon cures, produces no detrimental physical properties, has outstanding electrical properties, and exhibits excellent storage stability. The new additions and their descriptions follow:

Poly-Dispersion	(Active ingredient content by weight)
PBD-75	75% Bismate (bismuth dimethyl dithiocarbamate)
PMD-75	75% M-B-T (mercaptobenzothiazole)
PmTD-70	70% (methyl) Tuex (tetramethyl thiuram disulfide)
PMzD-75	75% Methazate (zinc dimethyl dithiocarbamate)
P(Se)D-70	70% Selenac E (selenium diethyl-dithiocarbamate)
PTD-75	75% Tellurac (tellurium diethyl-dithiocarbamate)
	(Blends)
PmTASD-70	17.5% (methyl) Tuex (tetramethyl thiuram disulfide)
	17.5% M-B-T-S (mercaptobenzothiazyl disulfide)
	35.0% Sulfur
PS(eT)D-70	43.75% Sulfur
	26.25% (ethyl) Tuex (tetraethyl thiuram disulfide)
PZND-84	72% Zinc oxide
	12% NA-22 (2-mercapto-imidazoline)

These Poly-Dispersions are said to incorporate rapidly, to disperse rapidly and uniformly. They are easy to use in any type of mixing process. Also, according to the manufacturer, they are very high in dispersion quality, easy to cut and weigh, are packaged in dustproof cartons, and eliminate spillage, dusting, and remnant loss.

A technical bulletin giving more detailed information and a price list are available from the company.



New Materials

SAG 470 Silicone Antifoam Emulsion

SAG 470 Silicone Antifoam Emulsion, a new, effective antifoam liquid designed for quenching foam in aqueous systems, has been developed by the silicones division of Union Carbide Corp., New York, N. Y. The new antifoam is reported to be a very stable, low-viscosity emulsion which is inexpensive to use and easy to handle. It is effective in quenching, preventing, or controlling foam, as desired.

SAG 470 Silicone Antifoam Emulsion is effective in many process applications, such as: adhesive and glue manufacture, rubber latex processing, distillations, paper making and finishing, evaporation and dehydration, textile finishing, leather tanning, and container filling. For example, in the manufacture of a rug backing compound, very alkaline, styrene rubber latex foamed as it was being charged to the kettle. Seven pounds of SAG 470 Emulsion effectively eliminated foam in 10,000 pounds of the latex compound, it was reported. It was also effective in many other instances such as monomer stripping of styrene-butadiene latex.

Although it is effective in suppressing or controlling foam, SAG 470 Emulsion is said to be most effective in preventing foam formation. The manufacturer therefore recommends that this material be added to the aqueous system before foaming starts.

Some typical physical properties of SAG 370 Emulsion are reported as follows:

Appearance	white, opaque
Silicone solids	10 wt.-%
Viscosity	1500–2500 cstks.
Weight/gallon	8.3 pounds
Storage stability	excellent

Price and further technical information are available from the company.

Vult-Accel E

Vult-Accel E is the first of a series of ready-to-use accelerator dispersions to be marketed by General Latex & Chemical Corp., Cambridge, Mass. It is a slurry of zinc diethyl dithiocarbamate in water, said to be useful in all types of latex compounding, and especially effective in the manufacture of latex foam. The slurry is non-sludging under ordinary circumstances and is readily dispersed after long standing, by gentle agitation. It must be protected from cold temperatures, as freezing will permanently damage the slurry.

Some typical physical properties of Vult-Accel E have been reported as follows:

Weight per gallon	10.0 lbs.
Total solids	51.5%
Total accelerator content	50.0%
Particle size (solids)	less than 10 microns

Stayb N2 Gellant

Stayb N2, a secondary gellant for latex compounds, is being marketed by Crusader Chemical Co., Inc., Baltimore, Md. This material is a low-viscosity alkaline water dispersion of insoluble salts having specific and carefully controlled composition. It decomposes under the influence of the coagulant and then carries a positive electrical charge. As it is supplied, it does not coagulate or cause flocculations when added to compounded or uncompounded alkaline latex systems. This liquid is amber in color and non-discoloring and non-staining to elastomers. It is supplied at 25% total solids; all the solids are effective ingredients.

Stayb N2 is recommended to be used within a range of two to five parts, as supplied, to 100 parts of the total latex compound, depending on the coagulating system used and the other processing conditions present. Used in foam rubber, Stayb N2 is said to be a very effective gelling and processing aid for operations using sodium silico fluoride gellants. Used in dipping and casting processes, Stayb N2 increases the rate of deposition and early wet strength of the deposited film.

Polytron Mixers

(*Continued from page 118*)

motors, will process from laboratory batches of ½-pint up to industrial batches of 2,500 gallons. The company maintains laboratory facilities for processing test samples and invites firms considering use of wet milling equipment to send such samples. A brochure, describing the four models, is available from the company on request.

D-S Thermatic Extruder

A completely new thermoplastic extruder series designed to meet the higher production requirements of the plastics and wire industries is being introduced by Davis-Standard, division of Franklin Research Corp., Mystic, Conn. Specifically engineered to deliver higher production in each bore size, the new D-S Thermatic series is available in 2½-inch, 3½-inch, 4½-inch, 6-inch and 8-inch models.

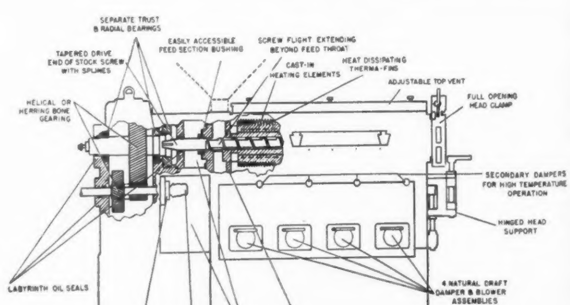
The 2½-inch model with a 20:1 L/D is now being tested. It is running at 160 rpm. and is delivering 240 lbs/hr. of polyvinyl chloride extrusions. Former D-S 2½-inch models, which have an excellent competitive production rate, delivered about 135 lbs/hr. at their maximum effective speed of 90 rpm. In the immediate future it is planned to increase the rpm. on this Thermatic extruder to 200.

The model being tested is said to have increased thrust and other bearing capacities. Bearing sizes are comparable to the next larger size of the old extruder series. Thrust bearings are sized for a minimum of 250,000 hours average life at 5,000 psi. and 100 rpm. of the screw.

New features of the Thermatic series include new helical, and in larger models, herringbone gearing. Lubrication for the gear set is sprayed on to bearing and mating surfaces by a force-feed system which insures complete lubrication even at extremely low operating speeds. A visual oil level gage provides a fast, constant indication of the oil supply.

A new four-keyway drive end on the Thermatic series stock screws is said to eliminate eccentric tendencies at high rpm. and to increase load bearing capacity of the screw. The entire drive end of the stock screw is tapered so that it can be easily disengaged from the drive gear and removed from the extruder.

The Thermatic series employs an improved version of the D-S Therma-Fin temperature control system. New, larger fins and heating elements in addition to new blower and damper arrangements provide precise temperature control for a complete range of thermoplastics even at maximum screw speeds. For further details request the new Thermatic series brochure.



Schematic diagram 2½-inch Thermatic extruder

NEW PRODUCTS

Cellular Rubber Pipe Insulation

New Cellular Tubing

Closed cellular rubber tubing produced by the Rubatex division, Great American Industries, Inc., Bedford, Va., is now being made available in wall thicknesses of $\frac{3}{16}$ inch, $\frac{1}{4}$ inch, $\frac{3}{8}$ inch, $\frac{1}{2}$ inch and $\frac{3}{4}$ inch with all standard diameters from $\frac{3}{8}$ inch to $4\frac{1}{8}$ inch to fit any piping insulation requirement. Designed to provide positive insulation for all warm or cold fluid piping, Rubatex tubing provides an effective seal to keep temperatures constant while preventing condensation on heating or cooling tubes.

Five foot lengths of tubing can be supplied to original equipment manufacturers, industrial, commercial or residential users in all inside diameter sizes. Random lengths are available up to and including $1\frac{1}{8}$ inch inside diameter. It can be ordered ready to slip directly onto piping or slit lengthwise to be sealed to piping with an adhesive.

This soft, flexible tubing can be easily installed onto piping with swings and bends up to 180° angle without additional cutting or fitting. Composed of thousands of minute nitrogen filled cells, the closed cellular structure of the tubing renders it lightweight, durable, fire resistant, and impervious to water and moisture, vermin and rot, according to the manufacturer. An added advantage is that it is not affected by ultra-violet sunrays and therefore can be installed before building walls are completed.

Goodyear's Super Hard Rock Lug Tire

New Off-the-Road Tire

A new off-the-road truck tire, squared off and widened in the shoulder area to give improved wear and traction, has been introduced by The Goodyear Tire & Rubber Co., Akron, O., for use in construction work.

Named the Super Hard Rock Lug, the tire is made in all wide-base sizes and is available in tubeless and tube-type versions. It is built with special cut-resisting rubber compounds and Goodyear's triple-tempered 3-T nylon cord.

Owing to the added rubber in the deepened and widened shoulder area, the tire's squared appearance, rather than conventional curved shape, means more of a working footprint in ground contact. Result, according to Goodyear, is a tire which provides a stronger bite, wears longer, and is resistive to shoulder snags and cuts.

Produced in company plants at Topeka, Kan., the Super Hard Rock Lug is available for nationwide distribution. Sizes range from 23.5-12, 16- and 20-ply rating; 26.5-20 and 26 ply; 29.5x25-28 ply; 29.5x29-22-, 28-, and 34-ply; and 33.5x33-26-, 32-, and 38-ply rating.

Nylon Steel Guard

A new nylon truck tire with steel cord breaker strips also has been introduced by Goodyear, Akron, O., for use in mining, logging, construction, and industrial sites and in other areas where sharp puncturing objects are a hazard.

Two criss-crossed steel cord breaker strips are built into the tire beneath the tread to protect an area considered most vulnerable to punctures. Combined wih triple-tempered 3-T nylon cord, the protective steel shield gives truck owners a low cost-per-mile tire for rugged use.

Named the Nylon Steel Guard, the tire is available in the Road Lug tread design, sizes 8.25-20 through 12.00-24. Three sizes of Hard Rock Steel Guard Nylon tires—11.00-22, Lug 14, 12.00-24, Lug 16, and 12.00-24, Rib 16—are also available.

BFG Foreign Car Snow Tires

B. F. Goodrich Tire Co., Akron, O., is importing nine sizes of winter traction tires for popular small foreign cars from its associate plants in Holland, Sweden, and Germany, making them available to tire dealers in the United States. All sizes, except one size made in Germany, have a tread similar to the BFG Trailmaker winter traction tread for American cars.

Seven of the sizes are tubeless. They are: 5.20-13, 5.60-13, 5.90-13, 6.40-13, 6.70-13, 5.00/5.60-15, and 5.50/5.90-15. The remaining two sizes, 5.60-14 and 5.00-16, are tube-type.

Early this year BFG placed on the market 16 sizes of standard passenger tires for import cars. Thirteen of these 16 sizes are made in BFG associate plants in Europe, the remainder in BFG United States plants. Addition of these winter traction tires gives the company a complete line of tires for imported cars.

Junior Horseshoe Set

A junior-size horseshoe set has been added to the toy line made by The Barr Rubber Products Co., Sandusky, O. The set consists of four junior-size shoes, two red, two black, and two bases with rounded-top pegs.

This horseshoe set is good for both indoor and outdoor use. It is safe for even very small children and aids in development of coordination. All pieces are washable and unbreakable.

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General's Super All Grip Truck Tire

A new, versatile truck tire, designated the Super All Grip, able to meet any and all weather and road conditions, has been announced by The General Tire & Rubber Co., Akron, O. For both summer and winter use, the new multi-purpose tire was designed for maximum traction and long tread life.

The new tire will reportedly pull through snow, slush, mud, and sand; it has superior stopping ability for wet or icy pavements. It provides longer tread life and excellent stability because of its greater non-skid tread depth and unique design.

The new Super All Grip has two center riding ribs—for smoother ride, noise elimination, and stability—flanked by angled cleats and open channels for tractive power and snow-mud ejection. The non-directional tread eliminates tire mounting problems.

The all-purpose tire is recommended especially for areas or lines of work where road conditions are subject to rapid changes and where varying surfaces are encountered, as in suburban delivery and other types of local hauling, or in hilly or mountainous terrain.

The new tire is made in both rayon and Nygen construction, tubeless and conventional types. In tubeless the sizes range from 7-17.5, six-ply through 9-22.5, 10-ply. In conventional tube-type construction, the sizes run from 6.70 x 15, six-ply through 10.00 x 20, 12-ply. The tire will soon be available throughout the country.

New Sponge Underlay

United States Rubber Co., New York, N. Y., is producing a flat sponge rubber underlay for carpets and rugs, called U. S. Airmaster, to be sold by the company's national branch sales organization directly to furniture stores, department stores, carpet specialty shops, and home furnishing outlets.

Airmaster is a full 300-gage (approximately ⅓-inch thick) made of highly resilient flat sponge rubber, with a tough white fiber backing. It is being produced in 36-inch and 53-inch widths.

New Trailer Spring

Bonded rubber spring

A new-type bonded rubber spring said to make possible cost and weight reductions in suspension systems for boat and utility trailers has been announced by Lord Mfg. Co., Erie, Pa. This spring provides better shock protection than conventional suspensions.

The compact spring is of a special shear sandwich construction with the rubber flexing element permanently bonded between two metal plate assemblies. It attaches between the axle bracket and the trailer frame and eliminates the sway brace now used on most conventional suspensions. This suspension can be adapted to all makes of trailers, the company reports.

The Lord spring provides good stability, multi-directional cushioning and inherent damping so that no auxiliary snubbers are needed. Parts available from stock can be used for trailers from 300 to 2,000 pounds capacity. These rubber springs and others like them are also adaptable to higher capacity and to four-wheel trailers, it is further claimed.

TECHNICAL BOOKS

BOOK REVIEWS

"Catalysis. Volume V. Hydrogenation, Oxo-Synthesis, Hydrocracking, Hydrodesulfurization, Hydrogen Isotope Exchange and Related Reactions." Edited by **P. H. Emmett. Cloth covers, $6\frac{5}{8}$** by $9\frac{1}{4}$ inches, 542 pages. Reinhold Publishing Corp., New York, N. Y. Price $15.00.

Volume V of "Catalysis" together with Volumes III and IV complete the discussion of catalytic hydrogenation in this series.

The first three chapters which deal with reactions of carbon monoxide would be valuable not only to a worker in the field, but also to one who wants an introduction to this area. Chapter I is a complete general survey of the reactions of carbon monoxide. This presentation is not merely a cataloging of reactions; it also discusses the role of the structure of carbon monoxide in these reactions, and, where possible, a discussion of the reaction mechanism is given.

Chapters 2 and 3 deal with specific reactions of carbon monoxide. Here also the presentation, while largely factual, does not omit structural considerations or discussions of mechanisms. In a sense these two chapters are the most satisfying in the current volume. They are well organized and well written and leave the reader with the impression that although the mechanism of these reactions is still not clearcut, the work already done (largely by the authors) suggests that a fuller understanding will be achieved shortly.

Chapter 4 is a survey of the literature on the hydrogenation of all types of aromatic compounds; the coverage is quite complete. This chapter does suffer in that little interpretation of the data is made, but this defect is probably a result of the fact that the volume of work covered is too enormous for critical discussion in a limited space. Chapter 5 on the use of hydrogen isotopes is comprehensive and critical. Although occasionally repetitive, it provides a thorough review of the complexities encountered in researches dealing with exchange and hydrogenation. This chapter covers not only heterogeneous catalytic reactions, but also those occurring by enzymatic and homogenous catalysis.

The last chapter summarizes the reason for and current approaches to hydrodesulfurization of petroleum. The discussion is intended primarily for petroleum chemists, and it should be of considerable interest to those persons working in this field.

As a whole, this volume is a valuable addition to the literature on catalysis. The topics discussed are handled with clarity and are well documented. Professor Emmett succeeded admirably in his intention stated in the preface: namely, "to blend discussions of the fundamentals of catalysis with a presentation of a summary of the factual matter. . ."

R. J. Kokes

"The Lognormal Distribution with Special Reference to Its Uses in Economics." By J. Aitchison and J. A. C. Brown. Cloth cover, $6\frac{5}{16}$ by $9\frac{3}{4}$ inches, 194 pages. Cambridge University Press, London and New York. Price $6.50.

This book presents a thorough and unified discussion of the lognormal distribution (the distribution of a variable whose logarithm follows the normal law of probability). Although a considerable volume of theory of the lognormal distribution has been built up over the last 50 years, statistics courses and statistics textbooks have in general avoided the subject.

Although the major applications of lognormal theory have been in economics and biology (probit analysis), many physical

Technical Books

and industrial processes deserve its attention. The distribution frequently arises in small-particle classification problems where the basis of classification is a diameter, volume, or surface area. Carbon black technologists should perhaps reexamine their work in this area in the light of the statistics of the lognormal distribution. Endurance tests of many kinds (measured in terms of the effective length of life of a material or piece of equipment) are frequently lognormal. Textile researchers according to Tippett,[1] also frequently encounter the distribution.

The book, Monograph 5 of the Department of Applied Economics, University of Cambridge, is authoritative and well written, but demands of the reader considerable familiarity with theoretical statistics.

[1] L. H. C. Tippett, "Statistical Methods in Textile Research," *Shirley Inst. Mem.*, 13, 35 (1934).

NEW PUBLICATIONS

Publications of Dow Corning Corp., Midland, Mich.:

"Engineering Guide to Silicone Fluids." 8 pages. This brochure covers the general mechanical properties and uses of the company's silicone fluids, including typical applications and characteristic properties.

"Selection Guide to Silicone Insulating Components." 6 pages. As the title indicates, this brochure contains a tabulated guide to insulating components for all types of electrical equipment. A materials selection guide is included.

"Sylkyd Enameled Wire." 4 pages. This brochure describes and gives typical properties of the company's Sylkyd enameled wire, a heat-stable film insulated wire reliable in 180, 155, and 130° C. systems. A plot showing thermal life of silicone insulation systems *versus* Class A system (AIEE No. 510 Test Procedure) is given.

"Dow Corning Silicones—1958 Guide." 16 pages. Those silicones listed in this booklet which are of interest to the rubber technologist include adhesives, defoamers, foaming resins, laminating resins, leather treatments, molding compounds, release agents, paint resins and additives, polyurethane foam additives, Silastic rubbers, textile finishes, and water repellents. Photographs, charts, tables, and references supplement the descriptions of these and other silicone products made by the company.

Publications of the E. I. du Pont de Nemours & Co., Inc., Elastomer-Chemicals Department, Wilmington, Del.:

"Blends of Hypalon with Other Elastomers and Plastics." BL-339. By B. J. McMartin. 10 pages. Hypalon is said to be not surpassed by other elastomers in ozone resistance, durability where exposed to weather, and in colorability and color stability on outdoor exposure. Under less severe conditions where such maximum service is not required, it is more economical to blend Hypalon with other elastomers, thus adding some measure of Hypalon's quality without undue sacrifice of physical properties. In this bulletin, blends with natural rubber, SBR, nitrile rubber and butyl are discussed. The use of Hypalon with PVC and polyethylene is also discussed.

"Diak No. 1—A Diamine Curing Agent for Viton Polymers." No. 58-7. By A. L. Moran. 3 pages. Diak No. 1, a blocked diamine curing agent, provides good processing safety and excellent vulcanizate properties for Viton A and Viton A-HV polymers. This report describes the properties of Diak No. 1 as well as the use of this material in Viton A and Viton A-HV stocks.

"Plasite Corrosion-Resistant Coatings." Bulletin No. 258. Wisconsin Protective Coating Co., Green Bay, Wis. 4 pages. This condensed bulletin describes Hypalon modified with phenolic and epoxy for a multitude of uses as tank linings for 73% caustic and protection of steel against oxidizing agents. Various formulations of Hypalon coatings are available as well as a complete line of cold-set tank lining materials.

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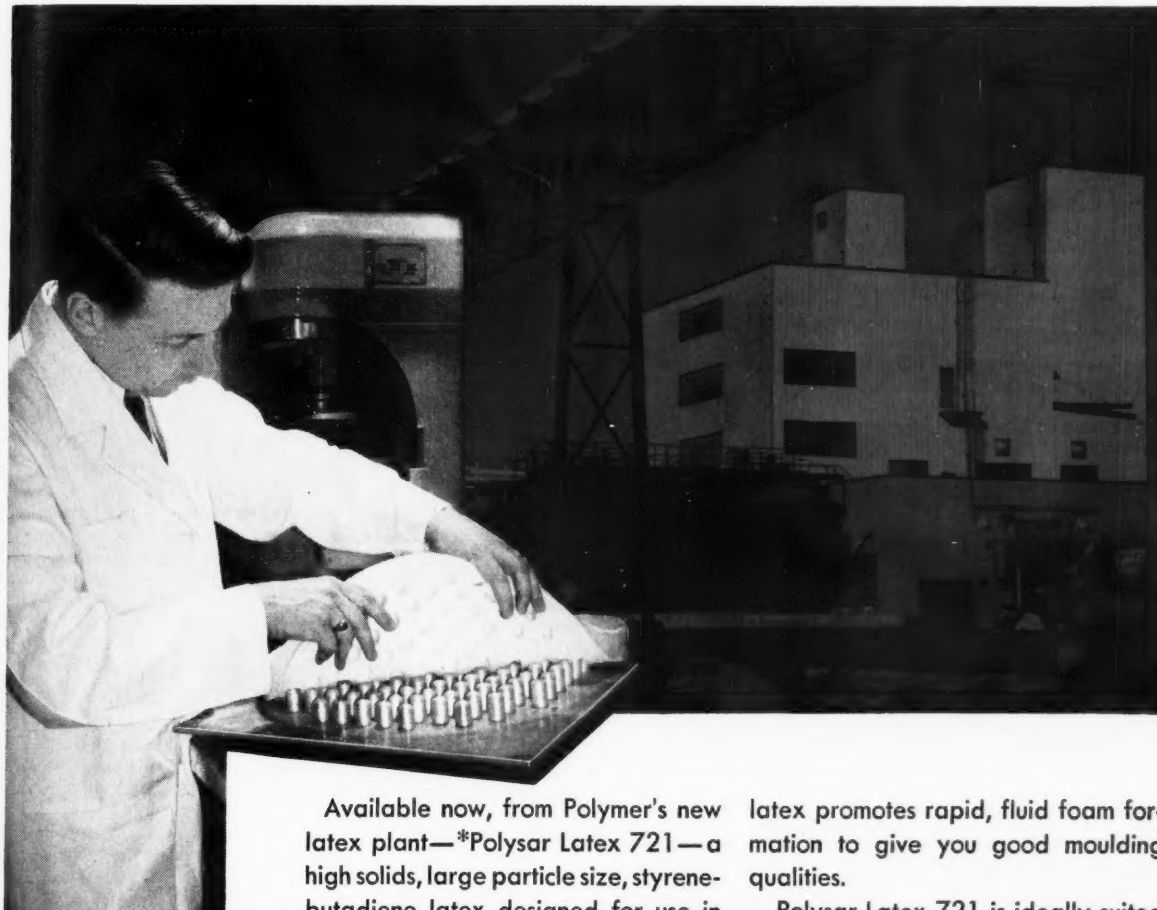

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Polysar Latex 721 is ideally suited to moulded applications, such as automotive seating, mattresses and pillows. It also offers important product advantages to manufacturers of sheet and slab stock for the furniture industry. The uniform particle size of Polysar Latex 721 should also prove useful to processors of various latex-based adhesives and coatings.

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Technical Books

"Ethylac as an Activator in SBR 1500." Pennsalt Chemicals Corp., Philadelphia, Pa. 4 pages. This technical bulletin gives the properties and vulcanizate data of Ethylac, 2-benzothiazyl-N,N-diethylthiocarbamyl sulfide, a light-yellow, low melting powder, essentially dustfree accelerator. The material is recommended for use as a primary accelerator and as a delayed-action activator for other primary accelerators in both natural rubber and SBR compounds.

"Model E-50 Portable Bagging Scale." Richardson Scale Co., Clifton, N. J. 2 pages. This two-color product data sheet describes and illustrates the firm's new versatile E-50 portable bagging scale designed for either power or gravity feed. The data sheet details the E-50's accurate weighing and bagging of free-running materials. When used for sluggish powders, meals, and other dusty and non-free flowing products, a V-belt driven agitator is supplied as standard equipment. Specifications and a line drawing showing dimensions are also included.

"B. F. Goodrich Package Conveyor Belts." B. F. Goodrich Industrial Products Co., Akron, O. 2 pages. This new data sheet on the company's package conveyor belts features a new ribbed design for Griptite belts that is self-cleaning and designed for use wherever packages range from very heavy to light weight. Every 18 inches on this belt a rib raised higher than the rest stops lightweight packages from sliding. Other types of belts are also discussed and illustrated.

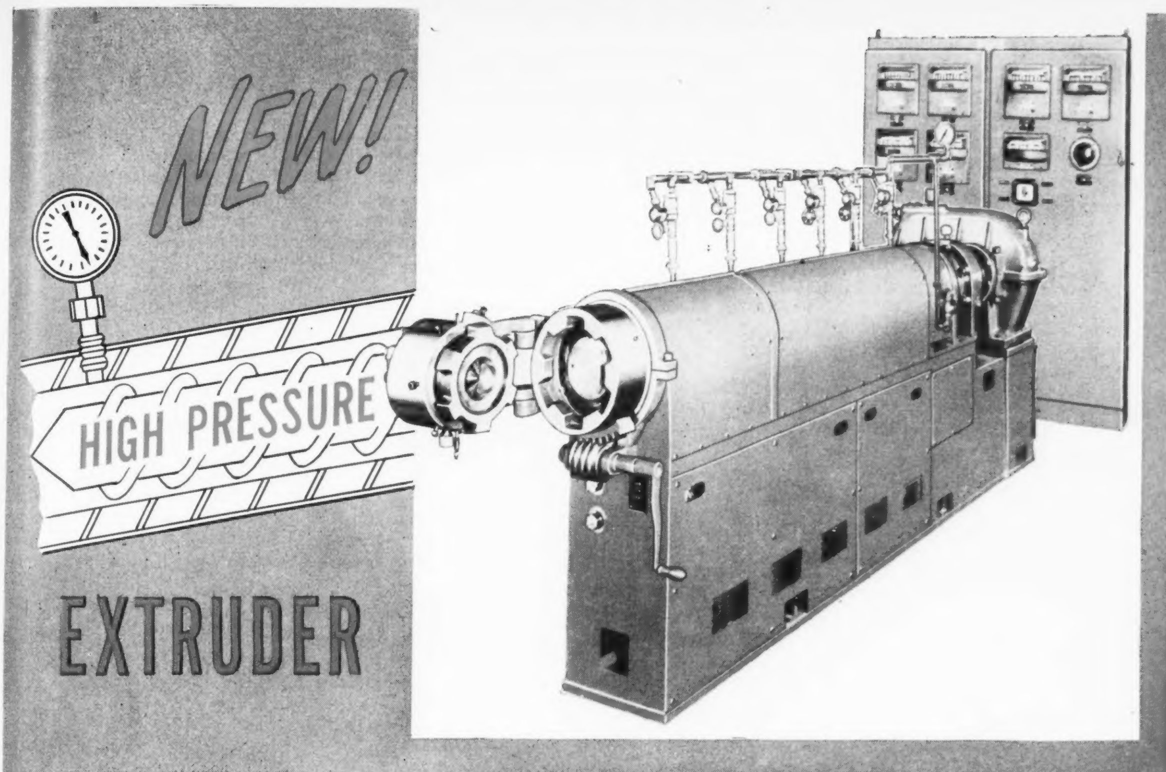
"Power and Heat Energy Relations in Polyethylene Extrusion." No. 105. Bakelite Co., Division of Union Carbide Corp., New York, N. Y. 24 pages. This paper presents a simplified analysis of the power and heat energy relations in the extruder and attempts to define further the conditions existent in the adiabatic state, a relation in which essentially all the necessary heat is generated by frictional working of the material in the screw channel of the extruder. A table giving extrusion data-normal extrusion information as well as plots are included.

"Wear — Usure — Verschleiss, An International Journal on Fundamentals of Friction, Lubrication, Wear and Their Control in Industry." Vol. I (1957/1958). Elsevier Publication Co., Amsterdam, Netherlands.

The aim of this journal, as the subtitle indicates, is to report on basic research on friction, lubrication, and wear, and the application of the results to industry. The first four issues to hand (August, October, December, 1957, and February, 1958) contain original papers as well as critical review articles dealing with frictional properties and wear-resistance of metallic, inorganic, and organic materials under laboratory and working conditions, in English, French, and German, by experts from Australia, Japan, India, the Soviet Union, the United States, and Europe. There are also abstracts of current literature and brief reports on current events.

"Heater-Dryer." Ball & Jewel, Inc., Brooklyn, N. Y. This brochure describes the firm's new heater-dryer which is used for attachment to plastics injection molding and extrusion machines. It tells how the heater-dryer conditions, dries and pre-heats the material in the hopper of the injection molding or extrusion machine, thus preventing contamination of the material and helping to increase production. Specifications for the five different size models are included.

"Rotaircool." Sprout, Waldron & Co., Inc., Muncy, Pa. 2 pages. This bulletin on equipment for cooling, drying, and conveying pellets explains the operation of the Rotaircool, a compact rotary pellet cooler and dryer with a built-in pneumatic conveying system for lifting pellets from the mill and exerting a cooling or drying influence on them from the time they are picked up to their discharge. Besides a close-up photograph and a diagrammatic cross-section, a typical system layout with approximate dimensions and equipment involved is included.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HIGH PRESSURE
EXTRUDER

Technical Books

"Formulating for Superior Whiteness with S-1006 and S-1502." SC:58-49. Shell Chemical Corp., Torrence, Calif. 12 pages. Formulations for several S-1006 and S-1502 white compounds are presented in this report to aid the compounder in obtaining light-colored products which are highly color-stable on exposure to light and non-staining on contact with organic finishes. These compounds are designed to give SBR vulcanizates with maximum whiteness over a range of physical properties. Applications include belt and hose covers for the food and drug industries; medical, dental, and surgical specialties; and heavy-duty wringer rolls.

"The Effects of Accelerator and Sulfur Concentrations on Ozone Resistance and Physical Properties in the Sulfur Type Cure." Bulletin 100-5. Thiokol Chemical Corp., Trenton, N. J. 16 pages. The purpose of this study is to evaluate various primary and secondary accelerators and the effect of varying sulfur concentrations on the vulcanization of butyl rubber. Materials used, introduction, test procedure, and conclusions are given. Included are tables and plots of the data obtained from the evaluation.

"Piccolyte Resins." Pennsylvania Industrial Chemical Corp., Clairton, Pa. 8 pages. This technical bulletin describes the company's line of Piccolyte resins, pale, non-yellowing terpene polymers available in solid or solution form. Designed as a reference work, this bulletin emphasizes physical and chemical properties and features charts covering compatibility, solubility, and viscosity. A chart is also included which gives the range of applications for various grades in rubber compounds and other industrial products.

"A Comparative Evaluation of Hycar Polymers." Manual HM-1. B. F. Goodrich Chemical Co., Cleveland, O. 40 pages. This booklet presents a comparative evaluation of the properties of the company's butadiene-acrylonitrile rubbers. Topics discussed include available Hycar polymers; Hycar 1041, 1042, 1043, 1014; effect of acrylonitrile content; Hycar 1001 and 1002 for best water resistance; low conversion Hycar polymers, Hycar 1052 and 1053; Hycar 1072 carboxylic polymer; Hycar 1312, a liquid nitrile polymer; and Hycar 1312 for medium or hard rubber compounds. Formulae, tables, physical properties, remarks, and suggested uses are included in this informative bulletin.

"Steam Turbine Generating Units." Allis-Chalmers Mfg. Co., Milwaukee, Wis. No. 03 B 7654A. 40 pages. Design and construction features of the firm's WA-series steam turbine-generating units rated through 16,500 kw are covered in this new bulletin. It carries cross-section diagrams of each of the four basic types of the units designed for condensing, non-condensing, condensing automatic extraction, and non-condensing automatic extraction operation. Turbine construction features covered include casings, glands, spindles and wheels, blades, nozzles and diaphragms, bearings, governing system, stop and throttle trip valves, insulation and lagging. It also describes such generator construction features as the stator, rotor, bearing, excitation systems, air-cooling and ventilation system for units 2,000 through 15,625 kw, and the hydrogen cooling used in the 16,500-kw unit. Copies of the bulletin are available from the firm.

"ADM Chemifats Chemical Products." Archer-Daniels-Midland Co., Minneapolis, Minn. 52 pages. Included in this new catalog on the company's aliphatic chemicals are test data on olefins, hydrocarbons, fatty alcohols, hydrogenated and vegetable fatty acids, glycerides, and sperm oil products. The catalog also contains the first commercial presentation of gas chromatographic composition data on olefins, hydrocarbons, fatty alcohols, and hydrogenated fatty acids. Solubility, compatibility, and physical constants charts are given for the various products. Intended as a technical reference, the booklet also is an introduction to the chemistry involved in working with these versatile chemicals for those just beginning to use them.

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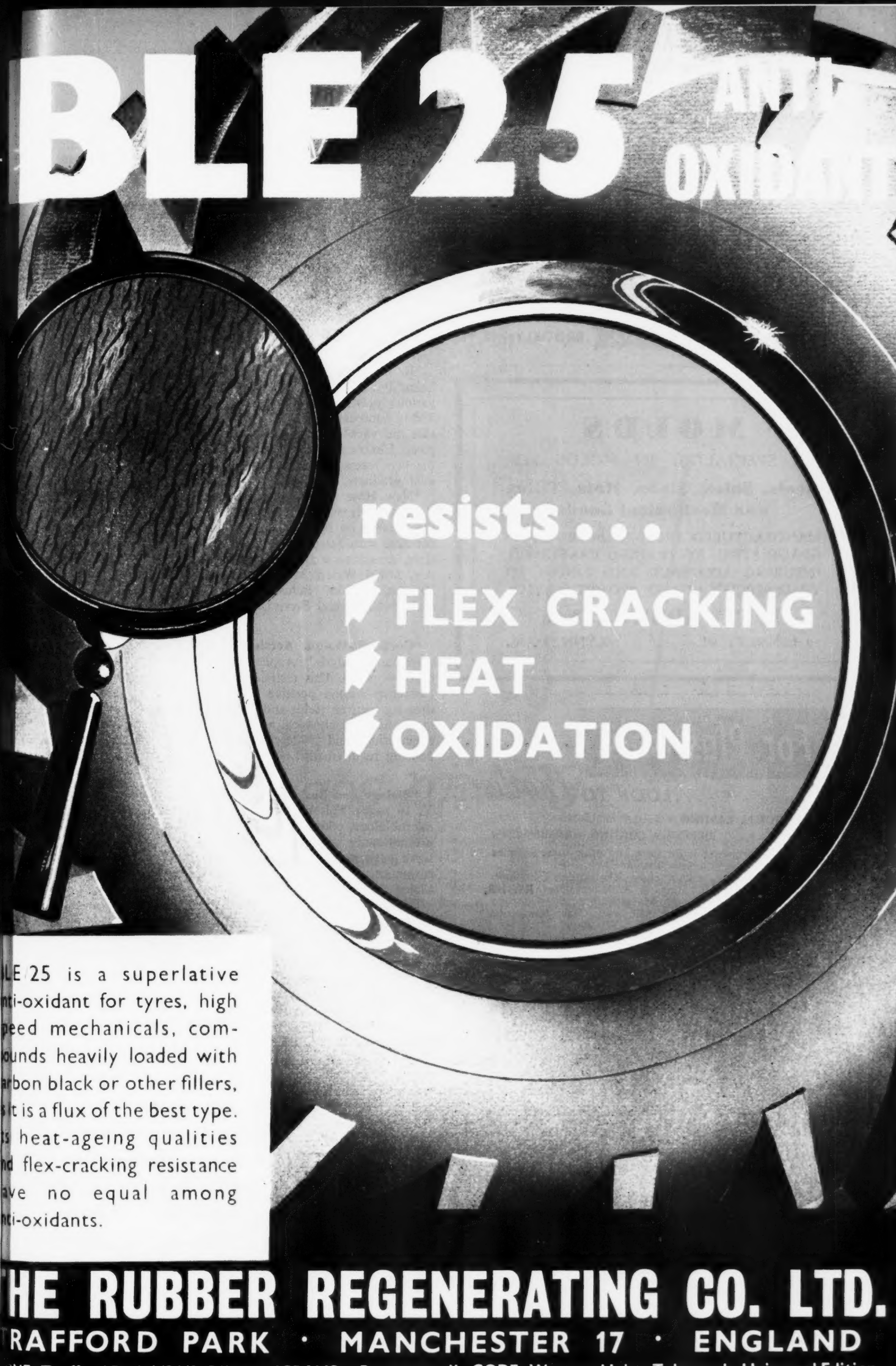
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Technical Books

Publications of Mine Safety Appliances Co., Pittsburgh, Pa.:

"M-S-A Particle Size Analyzer." No. 0708-1. 4 pages. This bulletin describes a new low-cost, general-purpose instrument for 0.1- to 40-micron particles. The complete analyzer system includes centrifuge tubes, feeding chamber, an optical tube projector, one or more special centrifuges, and tube handling and cleaning accessories. An illustrated description of basic steps in particle analysis is provided.

"M-S-A Portable Oxygen Indicator." No. 0817-1. 4 pages. Features and performance of new portable oxygen indicator, its principles of operation, uses, and accessories are included in this bulletin. The instrument can be used in the safety and industrial hygiene field to measure for oxygen deficiency conditions, and for situations of oxygen leakage.

"R/M Plastic Products." Raybestos-Manhattan, Inc., Manheim, Pa. 32 pages. This booklet illustrates and describes the various plastic products R/M manufactures from Kel-F and Teflon fluorocarbon resins. A wide selection of available products and the variety of services for which they are applicable are given. Electrical, mechanical, physical and chemical properties of the two resins are described. Sizes and tolerances of the available products are listed.

"New Hose Catalog Sections." Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J. These eight new catalog sections on hose cover most of the industrial types of rubber hose with detailed illustrations, data on construction, service, sizes, pressures, weights, and fittings. These sections are: M610 Air, M620 Water, M630 Steam, M640 Water Suction, M650 Petroleum, M660 Industrial Fire, M670 Spray and Welding, and M680 Special Service.

"Cockcroft-Walton Accelerators for Nuclear Chemistry and Chemical Analysis." Applied Radiation Corp., Walnut Creek, Calif. 6 pages. This technical bulletin describes the company's Cockcroft-Walton positive ion accelerators. It includes graphs showing neutron yields and energies, a discussion of applications in the fields of chemical analysis, nuclear chemistry and nuclear engineering, and a description of the accelerators and their housing requirements.

"Biology and Business." Foster D. Snell, Inc., New York, N. Y. 16 pages. This booklet covers such topics as toxicity testing, microbiology, odors and vapors, physiological and related testing, precautionary labeling, and other supplementary services. It may serve as a guide for manufacturers of drugs, pharmaceuticals, cosmetics, and proprietary products in understanding the role biology plays in business.

"Parco O-Rings Technical Data Reference Log." Catalog 1581. Plastic & Rubber Products Co., Los Angeles, Calif, 16 pages. This tabulated reference log gives detailed information on selecting O-rings, a cross-reference chart of O-ring size and part, numbers incorporating the uniform dash numbering system, and a table of standard size and installation data for O-ring seals.

"Adventures in Rubberland." Minnesota Rubber Co., Minneapolis, Minn. 16 pages. This four-color booklet describes the firm's manufacturing facilities in detail. It starts with a visit to the general offices, then to the research and development division, the Black Magic plant, the silicone plant, the plastic and latex plant, the Rainbow plant, and finally the engineering plant.

"Sturtevant Micronizer Grinding Machine." No. 0915M58. Sturtevant Mill Co., Boston, Mass. 4 pages. This fully illustrated brochure, incorporating new information on an additional model Micronizer, discusses its potential in fine grinding, contains typical grinding information, reveals steam and/or air requirements, and includes schematic drawings of the unit. It also shows how firms may take advantage of the company's fine-grinding laboratory for custom or experimental grinding work.

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	NON-PIGMENTED	PIGMENTED WITH PHILBLACK*
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COLD	PHILPRENE 1500 PHILPRENE 1502 PHILPRENE 1503	PHILPRENE 1601 PHILPRENE 1605
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MARKET REVIEWS

Natural Rubber

No real change in the natural rubber situation took place during the August 16-September 15 period under review. Although mitigated by the prospects of diplomatic talks, the political tension in the Far East appears to be building up, but neither this nor last month's heavy shipments from Malaya nor the poor overall July consumption here have been able to shake the markets out of their lethargy. Furthermore, the continued absence of Russian buying in London and of Chinese orders in Singapore has, in the face of reluctance on the part of the sellers, merely produced a state bordering on stalemate, and values in all markets have remained substantially unchanged.

The steady decline in the natural/-synthetic consumption ratio over the last several months may be attributed to two factors: (1) the present conditions in the automobile industry here and (2) the increasing synthetic production capacity which is progressively diminishing the needs of imports. The ratio, therefore, is becoming less important than the actual quantity of natural rubber consumed. Also, as the tonnage now available for rotation by the government stockpile is limited, the reduction in the free stocks of natural rubber in the United States to about 85,000 tons would not seem to be a very healthy position for such an important industry, especially as a fair proportion of the stocks may not be of the right grades usually sought by the consumers.

Recently Akron tire manufacturers took a more optimistic view of the labor situation in the automobile industry and bought substantial amounts of new rubber. Replacement demand from the primary markets improved also, it was reported.

August sales, on the New York Commodity Exchange, amounted to 6,290 tons, compared with 9,110 tons for July contract. There were 21 trading days in August and 20 during the August 16-September 15 period.

On the physical market, RSS #1, according to the Rubber Trade Association of New York, averaged 28.86¢ per pound for the August 16-September 15 period. Average August sellers' prices for representative grades were: RSS #3, 26.65¢; #3 Amber Blankets, 22.45¢; and Flat Bark, 19.39¢.

REX CONTRACT

	Aug. 22	Aug. 29	Sept. 5	Sept. 12
1958				
Sept.	28.80	29.15	29.00	29.20
Nov.	28.55	28.85	28.75	28.95
1959				
Jan.	28.40	28.65	28.55	28.70
Mar.	28.26	28.45	28.45	28.60
May	28.25	28.30	28.25	28.50
July	28.10	28.20	28.25	28.40
Sept.	28.00	28.20	28.20	28.30

NEW YORK OUTSIDE MARKET

	Aug. 22	Aug. 29	Sept. 5	Sept. 12
RSS #1	28.88	29.13	29.13	29.13
2	28.38	28.63	28.75	28.63
3	26.75	27.13	27.25	27.25
Pale Crepe				
#1 Thick	31.25	31.50	31.25	31.25
Thin	31.25	31.50	31.50	31.50
#3 Amber Blankets	22.50	22.63	22.75	23.00
Thin Brown Crepe	22.25	22.38	22.50	22.75
Standard Bark Flat	19.38	19.63	19.25	19.38

Latex

During the August 16—September 15 period, with latex still in ample supply, manufacturers appeared to have been content with following their hand-to-mouth policy, and it looks as if the heaviness overhanging the market will not be relieved until a somewhat better balance between supply and demand is restored. This could be brought about by a pick-up in business generally, which in some quarters is expected to occur during the late autumn, and considering the present unfavorable differential, some curtailment in latex production should perhaps not be ruled out.

Prices for ASTM Centrifuged Concentrated natural latex, in tank-car quantities, f.o.b., rail tank car, ran about 36.18¢ per pound solids. Synthetic latices prices were 21.5 to 38.2¢ for SBR; 37 to 53¢ for neoprene; and 46 to 60¢ per pound for the nitrile types.

Final June and preliminary July domestic statistics for all latices were reported by the United States Department of Commerce as given in the tabulation below:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
June	0	*	5,304	17,078
July	0	*	4,531	15,516
SBR				
June	4,539	—	4,165	7,337
July	3,645	—	3,433	6,693
Neoprene				
June	696	0	639	1,267
July	677	0	629	1,312
Nitrile				
June	890	0	919	1,888
July	893	0	703	1,990

*Not available yet for period covered.

Synthetic Rubber

Consumption of all types of synthetic rubber in the United States for August amounted to 70,811 long tons, compared with July's consumption of 63,865 tons, according to the regular monthly report of The Rubber Manufacturers Association, Inc. This August synthetic rubber consumption, the highest since January of this year, as well as the total new rubber consumption in August of 109,859 tons, would seem to be further confirmation that business activity is again on the upgrade after the decline since the first of the year.

Consumption by types of synthetic rubber in August, as compared with July use, in tons was as follows: SBR, 58,674 compared with 53,903; neoprene, 5,895, against 4,454; butyl, 4,068, against 3,791; and nitrile 2,174 against 1,717. Similar increases were registered in the production by types during August, as compared with July, and stocks on hand rose considerably for SBR, but remained at about their July levels for the other synthetics.

Exports dropped to 13,355 tons from the 14,730 tons of synthetic rubber sent abroad in July; the greater part of this decrease resulted from the decline in SBR exports from 10,602 tons in July to 9,750 in August. Exports of neoprene rose from 2,403 tons in July to 2,550 tons in August; while exports of butyl and nitrile rubbers declined significantly.

The synthetic rubber producing industry seemed generally in agreement that the Attorney General in his Third Report on competition in the synthetic rubber industry was unrealistic in interpreting uniform SBR prices as evidence of lack of competition in the industry. Although producers would like to obtain a higher price for SBR in view of their rising costs, it is still a buyers' market and the wrong place for any such increase at the present time.

The future for the synthetic rubber industry should continue promising, according to R. P. Dinsmore, Goodyear vice president. In a recent talk Dr. Dinsmore estimated not only higher synthetic rubber consumption both in the United States and abroad, but

higher use ratios, up to 70% for the Americas and 53% for the rest of the world in 1965, compared with 57% for the Americas and 19% for the rest of the world in 1956.

Reclaimed Rubber

Reclaimed rubber consumption stayed fairly steady over the summer period. The replacement tire business set new highs in sales volume, and this counteracted the lower sales level of original equipment tires. Replacement tire companies seem to be more aware of the advantages to be obtained from using reclaimed rubber in undertread and sidewall as well as carcass frictioning compounds.

Reclaimed rubber is now being used in truck tire undertread and sidewall compounds to counter blister problems, according to one source.

Reclaimed rubber consumption during the August 16-September 15 period remained fairly constant. Orders placed in early September, however, indicate that original equipment sales are on the upswing. The above-mentioned factors are responsible for the current stability of the reclaim market and also indicate that the consumption of reclaim will increase in the coming months.

According to one source, the reclaim business is beginning to show signs of a good pickup, and as soon as the automotive industry gets its labor problems settled, the reclaimers expect to be increasingly busy. Once production on 1959 cars gets in full swing, the reclaim market should further improve.

According to The Rubber Manufacturers Association, Inc., report, August production of reclaimed rubber reached 20,611 tons; while consumption was 22,387 long tons.

Reclaimed Rubber Prices

Whole tire, first line	$0.11
Third line	.1025
Inner tube, black	.16
Red	.21
Butyl	.14
Light carcass	.22
Mechanical, light-colored, medium gravity	.155
Black, medium gravity	.085

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity, at special prices.

Scrap Rubber

The scrap rubber market displayed a slightly firmer tone during the end of the August 16—September 15 period. Activity has picked up, and consumers have shown more interest in acquiring supplies. Mixed auto tires were unchanged, but prices for some tubes were stronger. Mixed auto tubes in the East held at 2.50¢, but moved up to 2.75¢ in the Midwest. Black passenger tubes were at 5.75¢, both in the East and Midwest. Synthetic butyl tubes held at 3.25¢ in the East, but were quoted at 3.50¢ at Akron.

	Eastern Points	Akron, O.
	Per Net Ton	
Mixed auto tires	$11.00	$12.00
S. A. G. truck tires	nom.	15.50
Peeling, No. 1	nom.	23.00
2	nom.	20.00
3	nom.	15.50
Tire buffings	nom.	nom.
	(¢ per Lb.)	
Auto tubes, mixed	2.50	2.75
Black	5.75	5.75
Red	6.25	6.25
Butyl	3.25	3.50

Rayon and Nylon

A new cellulosic yarn has been developed by members of American Tyrex Corp., New York, N. Y., exclusively for tire cord. The corporation has adopted Tyrex as the certification mark for the new yarn. The corporation, a non-profit organization formed to promote the use of the yarn, is composed of American Enka Corp., American Viscose Corp., Beaunit Mills, Inc., Courtaulds (Canada), Ltd., and Industrial Rayon Corp.

Tyrex tire yarn will be used in original equipment tires on 1959 automobiles. As production capacity for the new yarn is increased, it will be available for replacement tires. Although a price for the new yarn has not been set, it is expected to be competitive with the highest-strength rayon tire yarns now being marketed.

An increase of more than 200% in sales of nylon-cord passenger tires during the first half of 1958 was reported by Farmers' Union Central Exchange, South St. Paul, Minn., one of the nation's largest farm cooperatives. Nylon-cord tires now represent 65% of total passenger tire sales by this cooperative, as compared to 20% last year, it was reported.

All first-line passenger tires handled by Farmers' Union are made with nylon cord, and about one-half of the cooperative's second-line tires are built with nylon. Along with the increase in sales of nylon-cord passenger tires, there has been an accompanying hike in sales of nylon truck tires, with that type now accounting for approximately half of the total truck tire volume.

Total packaged production of rayon and acetate filament yarn during August was 53,600,000 pounds, consisting of 20,800,000 pounds of high-tenacity rayon yarn and 32,800,000 pounds of regular-tenacity rayon yarn. For July, production had been: total, 52,000,000 pounds, including regular-tenacity rayon yarn, 33,000,000 pounds; high-tenacity rayon yarn, 19,000,000 pounds.

Filament yarn shipments to domestic consumers for August totaled 58,300,000 pounds, of which 22,700,000 pounds were high-tenacity rayon yarn and 35,600,000 pounds were regular-tenacity rayon yarn. July shipments had been: total, 53,300,000 pounds; high-tenacity, 21,800,000 pounds; regular-tenacity, 31,500,000 pounds.

Rayon Prices

Tire Fabrics	
1100/490/2	$0.71 /$0.75
1650/908/2	.63 / .725
2200/980/2	.625/ .655
Tire Yarns	
High-Tenacity	
1100/ 490, 980	.50/ .64
1100/ 490	.59/ .63
1150/ 490, 980	.59/ .63
1165/ 480	.59/ .65
1230/ 490	.59/ .63
1650/ 720	.55/ .58
1650/ 980	.55/ .58
1875/ 980	.55/ .58
2200/ 960	.54/ .57
2200/ 980	.54/ .57
2200/1466	.64
4400/2934	.60
Super-High Tenacity	
1650/ 720	.665
1900/ 720	.58

Nylon Prices

Tire Yarns	
840/ 140	$1.10/$1.20
1680/ 280	1.20

Industrial Fabrics

During the close of the August 16—September 15 period the industrial grey cotton goods market was a mixed affair, in sales and prices. Slowly with a sort of inevitableness there has grown a contract backlog situation among mills that finds a number sold fairly full on some constructions, with little left in unsold stock.

There are cloths reported sold up to the year-end and others through October and also November. Nothing in this situation gives rise to the conclusion that any real danger lurks of true scarcity of anything. Prices will tend to keep on rising as mills and selling houses emerge from loss operations. They are considered still on the price losing side.

Because of a reviving interest in army ducks, prices were reduced approximately 1¢ a yard. Enameling duck, on the other hand, began to advance, some weights as much as 2-3¢ a yard over the lows of recent weeks. Price cuts of 2.5-3% were made in the wide and sail ducks on the card basis. Prices tightened about 2.5% on laundry ducks; the 90-ounce 120-inch wide, A grade, moved up to 40 and 5 off for larger amounts and 40 off for lesser yardages.

Inconsistency marks sales as higher prices are paid alongside of the identical-type goods and qualities lagging behind the upward movement elsewhere. To this extent the firmer price trend is not yet uniform. Buyers take

the position they are in a constructive price trend, but it has not yet evened itself out. The automotive market gives rise to a degree of caution.

Industrial Fabrics

Broken Twills*

54-inch, 1.14, 76x52	yd.	$0.52
58-inch, 1.06, 76x52		.565
60-inch, 1.02, 76x52		.5825

Drills*

59-inch, 1.85, 68x40	yd.	.35
2.25, 68x40		.2975

Osnaburgs*

40-inch, 2.11, 35x25	yd.	.2275
3.65, 35x25		.1525
59-inch, 2.35, 32x26		.26
62-inch, 2.23, 32x26		.275

Ducks

Enameling Ducks*

	S. F.	D. F.
38-inch, 1.78 yd.	$0.3263	.3313
2.00 yd.	.275	.28
51.5-inch, 1.35 yd.	.4588	.46
57-inch, 1.22 yd.	.4838	.50
61.5-inch, 1.09 yd.	.5413	.5538

Army Duck†

52-inch, 11.70 oz., 54x40 (8.10 oz./sq.yd.)	yd.	.5925

Numbered Duck†

List less 45%

Hose and Belting Duck*

Basis	lb.	.63

Sheeting*

40-inch, 3.15, 64x64	yd.	.2175
3.60, 56x56		.185
52-inch, 3.85, 48x48		.2275
57-inch, 3.47, 48x48		.235
60-inch, 2.10, 64x64		.36
2.40, 56x56		.31

Sateens*

53-inch, 1.12, 96x60	yd.	.565
1.32, 96x64		.52
57-inch, 1.04, 96x60		.615
58-inch, 1.02, 96x60		.625
1.21, 96x64		.5725

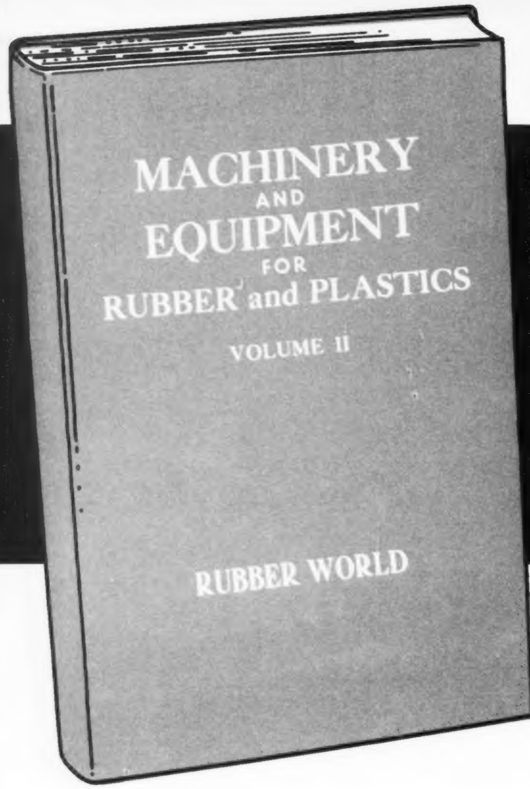
Chafer Fabrics*

14.40-oz./sq.yd. P.Y.	yd.	.73
11.65-oz./sq.yd. S.Y.		.61
10.80-oz./sq.yd. S.Y.		.6575
8.9-oz./sq.yd. S.Y.		.67
40-inch, 2.56, 35x25		.25
60-inch, 1.71, 35x25		.435

*Net 10 days.
†2% 10 days.

•

The National Association of Waste Material Dealers, Inc., New York, N. Y., is broadening its informational service to members of six NAWMD divisions, with a new commodity newsletter. The divisions are Waste Paper Institute, Cotton Rag Council, Wool Stock Institute, Textile Fibers Institute, Scrap Rubber & Plastics Institute, and Foreign Trade Division. The newsletter is edited by Harold C. Rowe, secretary of these divisions. The contents of the newsletter will deal with association, industrial, and individual news, as it relates to the six divisions.



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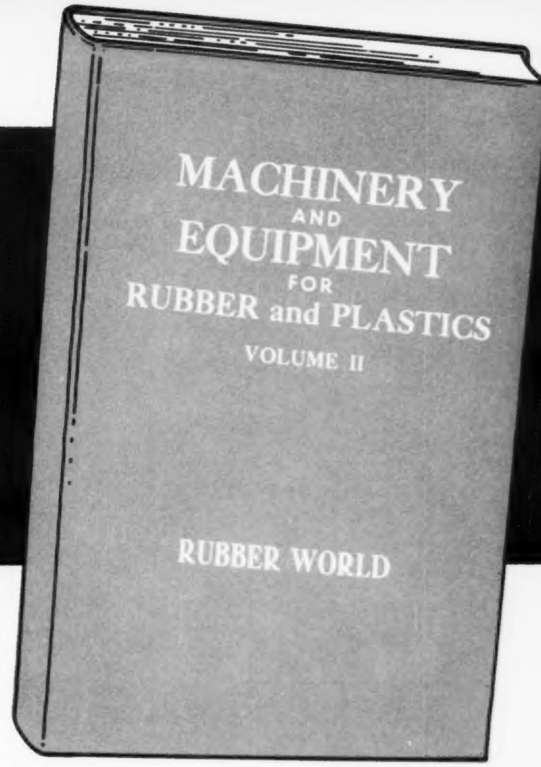

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STATISTICS of the RUBBER INDUSTRY

U.S.A. Imports and Production of Natural (Including Latex and Guayule) and Synthetic Rubber (in Long Tons)

Year	Natural	GR-S	SBR Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1952	805,575	636,969	17,885	81,630	65,745	16,228	1,624,454
1953	647,614	668,386	12,342	79,801	80,495	20,198	1,508,837
1954	597,200	472,698	17,707	58,802	69,150	21,396	1,236,601
1955	637,577	236,556	564,589	56,179	91,357	32,623	1,616,478
1956	579,217	....	877,430	75,922	99,412	34,567	1,667,841
1957							
Jan.	46,349	....	76,224	6,366	9,432	2,893	141,264
Feb.	37,487	....	66,023	5,664	9,004	2,894	121,072
Mar.	40,680	....	76,546	6,460	8,031	3,291	135,008
Apr.	59,896	....	65,706	5,890	8,902	2,408	142,802
May	52,566	....	77,542	6,145	9,235	2,561	148,049
June	30,290	....	68,297	4,474	9,678	2,538	137,553
July	44,760	....	67,796	1,972	8,591	2,592	125,711
Aug.	48,951	....	76,197	5,455	9,033	2,737	142,373
Sept.	47,937	....	75,872	6,113	9,726	2,826	142,474
Oct.	49,371	....	87,709	6,085	9,545	3,062	155,772
Nov.	44,583	....	87,152	6,099	9,976	2,803	148,362
Dec.	53,922	....	85,223	6,469	9,568	2,519	157,701
Total	553,043	....	907,534	66,936	110,721	33,124	1,671,358
1958							
Jan.	45,564	....	85,379	6,149	8,804	2,384	148,280
Feb.	46,018	....	66,402	4,996	8,200	2,157	127,773
Mar.	39,885	....	69,230	4,698	7,671	2,042	123,526
Apr.	41,278	....	59,263	4,324	7,973	2,197	115,035
May	36,183	....	62,161	4,462	7,450	2,338	112,594
June	....	....	62,567	1,926	7,251	2,306	......
July*	....	....	64,944	3,698	6,248	2,193	......

* Preliminary. Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Consumption of Natural (Including Latex) and Synthetic Rubber (Long Tons)

Year	Natural	GR-S	SBR Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1952	453,846	648,816	17,604	71,229	55,522	13,866	1,260,883
1953	553,473	611,748	12,433	77,826	65,900	16,929	1,338,309
1954	596,285	483,001	17,344	61,464	57,203	17,715	1,233,412
1955	634,800	234,963	507,034	53,991	72,876	26,035	1,529,699
1956	562,088	....	724,028	49,581	74,852	25,933	1,436,482
1957							
Jan.	52,631	....	70,978	5,028	7,237	2,247	138,121
Feb.	46,427	....	64,322	4,581	6,235	2,122	123,687
Mar.	48,263	....	67,853	4,998	6,559	2,240	129,913
Apr.	45,368	....	63,280	4,651	6,295	2,129	121,723
May	46,385	....	66,774	4,902	6,441	2,125	126,753
June	41,282	....	58,479	4,198	5,816	1,963	111,738
July	39,683	....	58,021	4,146	5,231	1,646	108,833
Aug.	44,846	....	66,089	4,461	6,502	2,220	124,204
Sept.	43,527	....	64,505	4,654	6,351	2,141	121,326
Oct.	48,782	....	73,850	5,343	7,194	2,433	137,602
Nov.	43,816	....	62,635	4,521	6,136	2,110	119,218
Dec.	38,285	....	56,432	3,930	5,464	1,811	105,922
Total	538,761	....	767,218	55,813	75,661	25,187	1,462,640
1958							
Jan.	42,597	....	60,179	4,508	5,928	2,010	115,222
Feb.	36,711	....	52,962	4,255	5,045	1,968	100,941
Mar.	38,191	....	54,816	4,297	4,965	1,962	104,231
Apr.	36,608	....	55,133	4,621	4,962	1,897	103,221
May	36,014	....	55,463	4,258	4,805	1,778	102,318
June	37,607	....	58,507	4,402	4,844	2,053	107,413
July*	34,235	....	50,470	3,791	4,454	1,717	94,667

* Preliminary. Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Stocks of Latex

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1956	12,262	7,327	1,421	2,217	10,965	23,227
1957						
Jan.	11.831	7,191	1,329	1,936	10,456	22.287
Feb.	9,940	7,415	1,169	2,051	10,635	20,575
Mar.	10,173	7,689	1,170	2,157	11.016	21,189
Apr.	12,064	8,096	1,183	1,836	11,115	23,179
May	11,733	7,885	1,407	1,710	11.002	22,735
June	10,931	8,139	1,377	2,001	11.517	22,448
July	12,073	8,045	1,296	1,953	11,294	23,367
Aug.	13,535	7.997	1,309	1,545	10.851	24,386
Sept.	12,315	7.566	1,141	1,700	10,407	23,722
Oct.	12,399	7,254	1,142	1,723	10.119	22,518
Nov.	12,316	7,558	1,265	1,927	10,750	23,066
Dec.	14,454	8,347	1,367	2,374	12,088	26,542
1958						
Jan.	14,178	8,222	1,190	2,052	11.464	25,642
Feb.	15,506	7,992	1,251	2,297	11.540	27.046
Mar.	16,825	7,991	1,281	1,974	11.246	28,071
Apr.	17,415	7,756	1,398	1,744	10.898	28,313
May	17,604	7,240	1,292	1,732	10,264	27,868
June	17,078	7,337	1,267	1,888	10,492	27,570
July†	15,516	6,693	1,312	1,990	9,995	25,511

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
*Includes SBR Types. † Preliminary.

U.S.A. Exports of Synthetic Rubber

(Long Tons)

Year	SBR Types	Butyl	Neoprene	N-Type	Total
1957					
Jan.	13,989	207	2,500	540	17,236
Feb.	13,353	439	2,505	482	16,779
Mar.	13,664	1,014	2,466	781	17,925
Apr.	10,625	372	2,244	620	13,861
May	12,208	603	2,480	517	15,808
June	13,886	762	2,315	492	17,455
July	14,444	1,169	3,426	631	19,670
Aug.	13.795	758	2,786	478	17,817
Sept.	11.625	540	1,964	396	14,525
Oct.	12.200	1,261	2,588	467	16,516
Nov.	12,639	809	2,521	410	16,379
Dec.	15,549	814	2,447	563	19,373
Total	158,017	8,832	30,242	6,377	203,468
1958					
Jan.	14,109	1,626	2,649	513	18,897
Feb.	9,947	1,415	2,626	378	14.366
Mar.	15,647	757	3,424	410	20.238
Apr.	11,583	949	2,356	698	15,586
May	14,067	1,218	2,899	784	18,968
June	11,995	1,022	1,562	473	15,052

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Stocks of Synthetic Rubber

(Long Tons)

Year	SBR Types	Butyl	Neoprene	N-Type	Total
1956	151,934	28,685	14,043	8,184	202,846
1957					
Jan.	143,177	29.810	13,073	7.664	193,724
Feb.	134,587	29.951	12,705	7,565	184.808
Mar.	131,255	30,814	11,949	7.795	181,813
Apr.	122,764	31,536	12.064	7,247	173,611
May	121,638	31.812	13,010	6.981	173,441
June	120,694	31,569	13,822	7,085	173,170
July	113,143	28.208	15,172	7,125	163.648
Aug.	111,962	28.339	14,603	6,784	161,688
Sept.	109,417	29.132	14,751	7.207	160,507
Oct.	113,382	29 008	15,181	7.134	164,705
Nov.	124,432	29.702	16,453	7.380	177,967
Dec.	140,199	31,489	18,943	7,954	198.585
1958					
Jan.	152,441	31,753	18,691	7,512	210,397
Feb.	151,501	31.369	18,408	7.635	208,914
Mar.	153,221	30,796	18,504	6.947	209.468
Apr.	143.981	30.012	18,764	6.469	199.226
May	137,277	29,246	19,014	6.392	191,929
June	132,800	25,954	18,736	6,231	183,721
July*	132,303	24,882	18,242	6,097	181,524

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
*Preliminary.

U.S.A. Consumption of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1957						
Jan.	6.994	6,288	856	841	7.985	14,979
Feb.	6,398	5.894	758	708	7,360	13,758
Mar.	7.081	6.370	784	799	7.953	15,034
Apr.	6,434	5,554	772	710	7.036	13,470
May	5.867	5,114	814	731	6.659	12,526
June	5.445	4,790	736	610	6,136	11,681
July	5.180	4,269	677	480	5,426	10,606
Aug.	6,499	5.758	784	823	7.365	13,864
Sept.	6.645	5.676	712	753	7.141	13,786
Oct.	7,250	6.556	788	857	8.201	15,451
Nov.	6.783	5,776	725	712	7,213	13,996
Dec.	5,933	5,260	633	606	6,499	12,432
Total	75,009	68,305	9,539	10,230	88,074	163.083
1958						
Jan.	6.380	5.438	806	683	6,927	13,307
Feb.	5,380	4,475	640	806	5,921	11,301
Mar.	5,560	4,708	633	720	6,061	11,621
Apr.	4,847	4,093	707	797	5,597	10,444
May	5.004	4,102	785	795	5,682	10,686
June	5,304	4.165	639	919	5,723	11,027
July†	4,531	3,433	629	703	4,765	9,296

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
*Includes SBR Types. † Preliminary.

U.S.A. Rubber Industry Sales and Inventories

(Millions of Dollars)

	Value of Sales*				Manufacturers' Inventories*			
	1955	1956	1957	1958	1955	1956	1957	1958
Jan.	424	415	496	448	790	935	1.047	1.100
Feb.	440	445	495	413	782	970	1.036	1,087
Mar.	466	451	476	412	805	979	1.030	1,112
Apr.	445	445	490	429	784	970	1,031	1,047
May	465	464	481	428	810	985	1.024	1,020
June	465	450	458	445	850	975	1,027	986
July	471	459	514		853	987	1.045	
Aug.	456	436	481	....	863	1,007	1.074	....
Sept.	456	429	481	....	874	1,007	1.074	....
Oct.	447	454	490	....	902	1,022	1.097	....
Nov.	482	463	431	....	935	1,024	1,101	....
Dec.	465	461	427		934	998	1,092	....
Total	5,493	5,372	5,720	....	Av. 845	988	12,678	....

Source: Office of Business Economics, United States Department of Commerce.
*Adjusted for seasonal variation.

U.S.A. Production of Cotton, Rayon, and Nylon Tire Fabrics

(Thousands of Pounds)

	Cotton and Nylon*		Rayon Tire Cord		
	Cotton Chafer Fabrics and Other Tire Fabrics	Cotton and Nylon Tire Cord and Fabrics	Woven	Not Woven	Total All Tire Cord and Fabrics
1957					
Jan.-Mar.	11,028	20,676	69,610	21,872	124,297
Apr.-June	10,456	24,852	63.195	16.037	115,418
July-Sept.	9.102	24.852	54.968	10,509	100,046
Oct.-Dec.	9,207	23,868	58,356	9,216	100,647
1958					
Jan.-Mar.	9,750	18,280	56,522	8,372	167,924
Apr.-June	7,890	24,725	....	....	....

* Cotton and nylon figures combined to avoid disclosing data for individual companies.
Source: Bureau of the Census, United States Department of Commerce.

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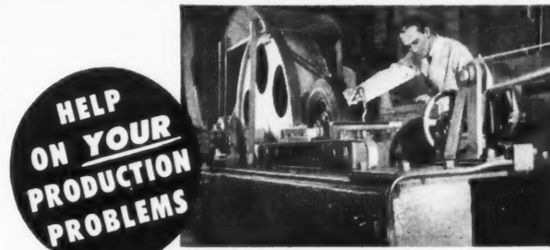

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U.S.A. Imports and Production of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1957						
Jan.	6,460	7,228	905	960	9,093	15,553
Feb.	4,342	6,481	724	1,035	8,240	12,582
Mar.	5,856	7,227	824	1,127	9,278	15,134
Apr.	8,812	6,306	976	881	8,163	16,975
May	5,794	5,495	1,082	933	7,510	13,304
June	4,809	5,251	819	886	6,956	11,765
July	6,243	4,646	572	844	6,062	12,305
Aug.	6,834	6,816	874	608	8,298	15,132
Sept.	5,516	5,649	917	1,285	7,851	15,268
Oct.	8,351	6,876	885	1,133	8,894	14,811
Nov.	6,496	6,515	1,021	994	8,530	15,026
Dec.	7,572	5,915	704	734	7,353	14,925
Total	69,513	74,405	10,403	11,637	96,445	165,958
1958						
Jan.	6,289	5,998	788	785	7,571	13,860
Feb.	7,013	3,852	765	671	5,288	12,301
Mar.	7,147	4,880	759	787	6,426	13,573
Apr.	6,348	3,889	907	830	5,626	11,974
May	4,121	3,635	808	882	5,325	9,446
June	....	4,539	696	890	6,125	....
July†	....	3,645	677	893	5,215	....

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
*Includes SBR types.
†Preliminary.

U.S.A. New Supply, Consumption, Exports, and Stock of Reclaimed Rubber

(Long Tons)

Year	New Supply	Consumption	Exports	Stocks
1957				
Jan.	25,103	24,053	1,288	34,552
Feb.	21,896	22,773	1,263	32,010
Mar.	25,088	24,633	1,298	30,975
Apr.	22,878	23,145	1,201	30,258
May	24,884	23,816	1,277	29,847
June	22,402	21,352	1,083	30,378
July	20,444	19,676	757	29,972
Aug.	20,423	22,429	917	28,521
Sept.	19,892	21,704	714	25,983
Oct.	26,419	24,925	1,230	27,171
Nov.	22,083	20,583	1,150	27,855
Dec.	20,101	18,263	843	29,323
Totals	273,989	266,852	13,021	29,323
1958				
Jan.	21,159	21,186	892	29,569
Feb.	18,319	18,130	665	28,838
Mar.	19,601	19,300	1,025	28,984
Apr.	19,818	19,746	832	29,440
May	18,942	20,104	1,012	27,862
June	20,549	20,652	1,024	27,763
July*	17,753	18,350	....	26,442

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
* Preliminary.

Carbon Black Statistics—Seven Months, 1958

Furnace blacks are classified as follows: SRF, semi-reinforcing furnace black; HMF, high modulus furnace black; GPF, general-purpose furnace black; FEF, fast-extruding furnace black; HAF, high abrasion furnace black; SAF, super abrasion furnace black; ISAF, intermediate super abrasion furnace black.

(Thousands of Pounds)

	Jan.	Feb.	Mar.	Apr.	May	June	July
Production							
Furnace types							
Thermal	12,159	10,070	11,942	10,436	9,378	9,598	10,282
SRF	22,704	17,946	18,714	14,587	14,750	14,094	18,986
HMF	5,769	3,190	5,242	4,302	5,257	6,383	5,134
GPF	4,470	4,852	4,632	4,872	5,183	4,418	4,874
FEF	16,992	16,398	18,272	17,880	13,384	14,141	14,776
HAF	39,384	32,054	33,735	42,134	35,256	35,817	40,137
SAF	—	728	968	934	67	82	—
ISAF	13,888	14,739	16,522	12,782	11,011	10,007	14,626
Total furnace	115,330	99,977	110,027	107,927	94,286	94,540	108,815
Contact types	28,574	25,712	27,328	26,051	26,623	26,105	28,134
Totals	143,904	125,689	137,355	133,978	120,909	120,645	136,949
Shipments							
Furnace types							
Thermal	12,237	8,648	8,762	10,034	8,126	8,703	9,260
SRF	21,706	18,360	19,869	23,201	19,589	18,612	19,796
HMF	5,320	5,030	4,355	5,735	4,682	6,066	6,309
GPF	5,589	4,793	3,721	4,267	3,945	4,885	5,146
FEF	17,609	17,285	16,780	17,988	15,821	14,908	18,607
HAF	35,550	32,938	34,433	37,390	36,802	36,620	38,425
SAF	531	387	560	358	319	809	769
ISAF	14,359	12,590	14,332	14,310	13,254	13,181	15,489
Total furnace	112,901	100,031	102,812	113,283	102,547	103,784	113,801
Contact types	25,571	23,072	23,617	25,863	26,091	23,106	23,645
Totals	138,472	123,303	126,429	139,146	128,638	137,446	137,446
Producers' Stocks, End of Period							
Furnace types							
Thermal	20,086	21,508	24,688	25,090	26,342	27,237	28,259
SRF	75,022	74,608	73,453	64,906	60,123	55,605	54,795
HMF	10,674	8,834	9,721	8,288	8,863	9,180	8,005
GPF	8,409	8,468	9,379	9,917	11,090	10,623	10,351
FEF	32,930	32,043	33,535	33,427	30,990	30,223	26,392
HAF	57,104	56,220	55,522	60,266	58,720	57,917	59,629
SAF	7,388	7,729	8,137	8,713	8,457	7,730	6,961
ISAF	49,406	51,555	53,745	52,217	49,974	46,800	45,937
Total furnace	261,019	260,965	268,180	262,824	254,559	245,315	240,329
Contact types	83,776	86,216	89,927	89,885	90,417	93,141	97,630
Totals	344,795	347,181	358,107	352,709	344,976	338,456	337,959
Exports							
Furnace types							
Total furnace	23,723	22,719	25,720	24,534	21,879	22,417	....
Contact types	13,519	10,933	14,018	12,143	12,698	13,369	....
Totals	37,242	33,652	39,738	36,677	34,577	35,786	....

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.

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World Production of Synthetic Rubber

(1,000 Long Tons)

Year	U.S.A.	Canada	Germany	Total
1957				
Jan.	94.3	11.1	0.9	106.2
Feb.	83.2	9.8	1.1	94.1
Mar.	93.9	11.1	1.1	106.1
Apr.	82.3	11.0	1.0	94.3
May	95.0	11.5	0.8	107.3
June	84.4	11.3	1.1	96.8
July	81.0	10.1	0.8	91.9
Aug.	93.4	11.0	1.1	105.6
Sept.	94.5	10.9	1.0	106.4
Oct.	106.4	11.4	1.1	118.9
Nov.	106.0	11.5	1.0	118.5
Dec.	103.8	11.5	0.6	115.9
Total	1,118.3	132.1	11.6	1,262.0
1958				
Jan.	102.7	10.9	1 8	115.4
Feb.	81.8	9.1	1.0	91.9
Mar.	83.6	11.3	1.2	96.2
Apr.	73.8	11.1	1.1	85.9
May	76.4	11.2	1.2	88.8
June	74.1	10.2	...	...

Source: Secretariat of the International Rubber Study Group; and Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

World Consumption of Natural Rubber

(1,000 Long Tons)

Year	United States	Eastern Europe and China	United Kingdom	Other Foreign	Total Foreign	Grand* Total
1957						
Jan.	52.6	13.0	14.4	74.9	102.3	155.0
Feb.	46.4	19.9	14.5	72.7	107.1	152.5
Mar.	48.3	23.6	17.6	72.7	113.9	162.5
Apr.	45.4	32.2	13.6	76.6	122.4	167.5
May	46.5	10.3	14.5	79.3	104.1	150.6
June	41.3	25.4	17.2	74.8	117.4	158.7
July	39.7	25.3	14.0	76.2	115.5	155.0
Aug.	44.9	28.0	9.7	66.8	104.5	150.0
Sept.	43.7	18.7	18.1	78.4	115.2	157.5
Oct.	48.8	12.2	15.3	75.7	106.2	155.0
Nov.	43.8	19.2	15.1	...	108 8	152.5
Dec.	38.3	18.5	17.7	70.8	104.2	142.5
Total	539.8	263.5	181.6	885.5	1,330.2	1,870.0
1958						
Jan.	42.6	21.8	15.3	73.5	110.6	152.5
Feb.	36.7	30.5	16.1	71.5	118.1	155.0
Mar.	38.2	31.6	16.9	73.7	122.2	160.0
Apr.	36.6	43.0	13.4	72.8	115.6	165.0
May	36.0	28.7	14.7	71.6	100.3	150.0
June	37.6	...	16.1	...	....	167.5

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce; and Secretariat of the International Rubber Study Group.
*Estimated.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)

Year	U.S.A.	Canada	United Kingdom	Total† Continent of Europe	World† Grand Total
1957					
Jan.	85.5	4.4	3.7	11.5	110.0
Feb.	77.9	4.2	3.9	11.3	102.5
Mar.	81.7	4.3	5.4	11.5	110.0
Apr.	76.4	4.2	4.0	12.3	102.5
May	80.2	4.7	4.8	12.5	107.5
June	70.5	4.2	5.5	12.3	97.5
July	69.0	3.5	4.3	14.0	97.5
Aug.	79.3	2.8	3.0	11.2	102.5
Sept.	77.7	3.7	6.4	14.0	110.0
Oct.	88.8	4.1	5.5	14.8	120.0
Nov.	75.4	4.0	5.0	14.0	105.0
Dec.	67.6	3.6	6.0	13.3	95.0
Total	929.3	47.5	57.4	154.8	1,262.5
1958					
Jan.	72.6	3.5	5.2	14.0	100.0
Feb.	64.2	3.5	5.2	13.5	92.5
Mar.	66.0	3.5	6.6	14.3	97.5
Apr.	66.6	3.8	4.7	13.5	95.0
May	66.3	4.0	5.5	13.3	95.0
June	69.8	4.5	6.0	...	100.0

Source: Secretariat of the International Rubber Study Group; Bureau of the Census, Industry Division, Chemical Branch, U. S. Department of Commerce.
* Includes latices. † Figures estimated or partly estimated.

World Production ot Natural Rubber

(1,000 Long Tons)

Year	Malaya Estate	Malaya Native	Indonesia Estate	Indonesia Native	All Other	Total
1957						
Jan.	36.1	27.3	23.8	22.7	45.1	155.0
Feb.	27.1	22.1	20.6	16.4	38.8	125.0
Mar.	26.0	21.1	19.7	46.1	52.2	165.0
Apr.	26.6	22.5	19.6	41.6	39.8	150.0
May	27.2	18.3	18.1	30.4	43.5	137.5
June	29.7	21.6	20.4	29.5	43.8	145.0
July	32.5	24.1	21.0	65.9	46.5	192.5
Aug.	33.0	23.2	21.8	52.4	44.8	175.0
Sept.	31.5	21.4	21.8	37.8	35.0	157.5
Oct.	33.4	22.6	22.2	32.8	54.0	165.0
Nov.	34.4	22.7	22.2	24.5	51.2	155.0
Dec.	32.4	22.1	21.1	32.4	62.0	170.0
Total	369.8	268.9	252.2	432.3	556.7	1,892.5
1958						
Jan.	35.8	25.4	22.5	11.5	52.5	145.0
Feb.	28.8	22.9	20.0	8.8	37.0	117.5
Mar.	28.4	20.3	19.7	27.5	46.5	142.5
Apr.	26.7	18.3	16.8	24.0	44.2	130.0
May	27.2	18.2	17.7	20.1	44.3	127.5
June	31.2	21.9	19.7	26.0	43.7	142.5

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce; Secretariat of the International Rubber Study Group.

U.S.A. Synthetic Rubber Industry, Wages, Hours

Year	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings
1956	104.67	41.7	2.51
1957			
Jan.	106.30	41.2	2.58
Feb.	104.19	40.7	2.56
Mar.	104.86	40.8	2.57
Apr.	103.94	40.6	2.56
May	105.93	40.9	2.59
June	103.88	39.8	2.61
July	108.75	41.2	2.64
Aug.	109.34	40.8	2.68
Sept.	108.40	40.6	2.67
Oct.	108.14	40.5	2.67
Nov.	112.73	41.3	2.73
Dec.	112.34	41.3	2.72
1958			
Jan.	109.62	40.6	2.70
Feb.	109.21	40.6	2.69
Mar.	110.03	40.6	2.71
Apr.	108.14	40.2	2.69
May	110.03	40.6	2.71

Source: BLS, United States Department of Labor.

U.S.A. Automotive Inner Tubes

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1957						
Jan.	274	3,263	72	3,608	2,918	6,294
Feb.	267	2,964	61	3,292	3,362	5,960
Mar.	240	3,057	100	3,397	3,822	6,540
Apr.	311	2,708	85	3,104	3,428	6,969
May	301	2,827	86	3,214	3,548	7,422
June	275	3,141	69	3,485	3,025	6,946
July	258	3,364	86	3,708	2,941	6,287
Aug.	243	3,358	81	3,683	3,134	5,966
Sept.	213	3,180	90	3,483	3,365	6,174
Oct.	242	2,809	121	3,172	3,764	6,909
Nov.	259	2,468	65	2,792	2,585	6,250
Dec.	225	2,392	101	2,717	2,778	7,671
Total	3,045	35,684	1,077	39,806	39,763	
1958						
Jan.	232	4,005	71	4,309	3,344	6,699
Feb.	209	3,014	73	3,296	3,443	6,983
Mar.	209	3,481	74	3,764	3,685	7,066
Apr.	223	2,956	64	3,243	3,624	7,609
May	225	2,742	68	3,035	3,530	8,189
June	202	3,332	67	3,601	3,476	8,156
July	215	3,174	76	3,466	2,890	7,680

Source: The Rubber Manufacturers Association, Inc.

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U.S.A. Automotive Pneumatic Casings

(Thousands of Units)

	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
Passenger Car						
1954	29,746	47,043	928	77,717	76,806	12,228
1955	42,574	50,156	966	93,698	97,232	15,963
1956	30,874	42,411	876	85,000	95,546	16,494
1957						
Jan.	3,192	4,521	100	7,812	8,296	16,978
Feb.	3,017	4,453	68	7,538	8,047	17,376
Mar.	3,051	4,875	80	8,006	8,629	18,065
Apr.	2,809	5,218	78	8,104	7,878	17,821
May	2,831	5,166	60	8,057	8,313	18,050
June	2,623	5,532	63	8,217	7,462	17,322
July	2,719	5,826	65	8,611	7,449	16,097
Aug.	2,886	5,675	66	8,627	7,801	15,348
Sept.	1,398	5,096	70	6,564	7,535	16,310
Oct.	2,298	4,392	88	6,778	8,437	17,998
Nov.	3,179	3,250	62	6,491	6,575	15,596
Dec.	2,803	2,858	78	5,739	6,597	19,818
Total	32,724	56,605	888	90,217	93,547	19,818
1958						
Jan.	2,376	4,838	50	7,264	6,740	19,298
Feb.	1,998	3,777	57.5	5,833	6,320	19,820
Mar.	1,845	4,726	49.3	6,621	6,569	19,786
Apr.	1,594	5,517	61.4	7,173	6,522	19,051
May	1,874	5,593	55.8	7,523	6,715	18,263
June	1,667	6,387	62.8	8,117	7,306	17,465
July	1,756	6,502	60.0	8,318	6,368	15,490
Truck and Bus						
1954	3,592	8,111	826	12,529	12,347	2,546
1955	4,801	9,034	910	14,746	14,957	2,815
1956	4,548	8,894	883	14,326	14,589	3,378
1957						
Jan.	305	678	83	1,066	1,208	3,512
Feb.	344	598	59	1,001	1,122	3,633
Mar.	330	704	74	1,107	1,136	3,678
Apr.	438	771	49	1,277	1,072	3,486
May	399	620	74	1,094	1,178	3,580
June	370	715	64	1,149	1,027	3,461
July	349	819	61	1,229	994	3,219
Aug.	328	813	65	1,206	1,117	3,129
Sept.	290	805	63	1,158	1,105	3,083
Oct.	322	959	94	1,375	1,271	2,987
Nov.	337	626	59	1,021	1,060	3,207
Dec.	266	484	70	820	1,018	3,408
Total	4,041	8,544	845	13,430	13,394	3,408
1958						
Jan.	277	674	57	1,007	1,074	3,470
Feb.	254	598	52	904	994	3,572
Mar.	269	608	46	923	1,004	3,659
Apr.	282	666	55	1,002	955	3,607
May	299	626	54	980	938	3,571
June	265	794	54	1,113	988	3,456
July	265	940	51	1,255	920	3,114
Total Automotive						
1954	33,338	55,154	1,754	90,246	89,153	14,774
1955	47,375	59,191	1,878	108,447	112,178	18,778
1956	35,423	62,147	1,759	99,327	100,407	19,872
1957						
Jan.	3,496	5,199	183	8,878	9,504	20,490
Feb.	3,361	5,052	127	8,539	9,169	21,009
Mar.	3,381	5,579	154	9,114	9,766	21,743
Apr.	3,246	5,989	146	9,381	8,950	21,308
May	3,230	5,787	134	9,150	9,490	21,630
June	2,993	6,247	127	9,366	8,489	20,783
July	3,068	6,646	126	9,840	8,443	19,316
Aug.	3,214	6,488	130	9,833	8,917	18,477
Sept.	1,688	5,902	133	7,723	8,641	19,393
Oct.	2,620	5,351	182	8,154	9,708	20,985
Nov.	3,516	3,876	121	7,513	7,636	18,803
Dec.	3,070	3,341	148	6,559	7,615	23,225
Total	36,764	65,150	1,734	103,647	106,941	23,225
1958						
Jan.	3,653	5,511	107	8,271	7,814	22,769
Feb.	2,253	4,374	110	6,737	7,314	23,392
Mar	2,114	5,334	95	7,543	7,573	23,446
Apr.	1,876	6,183	116	8,175	7,477	22,658
May	2,173	6,220	110	8,503	7,652	21,834
June	1,932	7,182	117	9,231	8,293	20,920
July	2,020	7,442	111	9,573	7,288	18,604

Source: The Rubber Manufacturers Association, Inc.

U.S.A. Rubber Industry Employment, Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumer's Price Index
All Rubber Products					
1939	121.0	$27.84	39.9	$0.75	
1957					
Jan.	216.0	91.21	40.9	2.23	118.2
Feb.	212.6	90.80	40.9	2.22	118.7
Mar.	211.4	89.28	40.4	2.21	118.9
Apr.	191.3	87.60	40.0	2.19	119.3
May	204.6	88.80	40.0	2.22	119.6
June	196.8	91.21	40.9	2.23	120.2
July	199.9	94.16	41.3	2.28	120.8
Aug.	204.3	92.84	40.9	2.27	121.0
Sept.	206.4	93.02	40.8	2.29	121.1
Oct.	209.5	93.03	40.1	2.32	121.1
Nov.	209.0	93.20	40.0	2.33	121.6
Dec.	207.3	92.40	40.0	2.31	121.6
1958					
Jan.	260.5	87.48	38.2	2.29	122.3
Feb.	256.9	85.04	37.3	2.28	122.5
Mar.	243.6	87.02	38.0	2.29	123.5
Apr.	234.7	85.88	37.5	2.29	123.6
May	230.4	87.86	38.2	2.30	123.7
Tires and Tubes					
1939	54.2	$33.36	35.0	$0.96	
1957					
Jan.	87.4	107.64	41.4	2.60	
Feb.	86.8	106.19	41.0	2.59	
Mar.	86.9	102.40	40.0	2.56	
Apr.	71.1	103.46	40.1	2.58	
May	84.9	103.46	40.1	2.58	
June	78.2	107.23	41.4	2.59	
July	84.4	112.20	42.5	2.64	
Aug.	84.2	107.83	41.0	2.63	
Sept.	84.4	107.20	40.3	2.66	
Oct.	84.4	105.18	39.1	2.69	
Nov.	84.0	106.62	39.2	2.72	
Dec.	83.6	105.84	39.2	2.70	
1958					
Jan.	109.2	98.52	36.9	2.67	
Feb.	105.6	93.02	35.1	2.65	
Mar.	102.5	98.05	37.0	2.65	
Apr.	98.4	95.67	36.1	2.65	
May	96.4	99.86	37.4	2.67	
Rubber Footwear					
1939	14.8	$22.80	37.5	$0.61	
1957					
Jan.	18.3	71.76	39.0	1.84	
Feb.	17.8	72.10	39.4	1.83	
Mar.	17.8	72.86	39.5	1.84	
Apr.	17.5	70.64	38.6	1.83	
May	17.3	71.92	39.3	1.83	
June	17.4	72.29	39.5	1.83	
July	16.9	72.13	39.2	1.84	
Aug.	17.2	73.05	39.7	1.84	
Sept.	17.6	74.45	39.6	1.88	
Oct.	17.7	76.02	39.8	1.91	
Nov.	18.0	78.96	40.7	1.94	
Dec.	17.9	79.35	40.9	1.94	
1958					
Jan.	21.8	74.87	39.2	1.91	
Feb.	21.5	74.68	39.1	1.91	
Mar.	20.9	76.61	39.9	1.92	
Apr.	20.7	75.46	39.3	1.92	
May	20.6	75.85	39.3	1.93	
Other Rubber Products					
1939	51.9	$23.34	38.9	$0.61	
1957					
Jan.	110.3	81.39	40.9	1.99	
Feb.	108.0	81.18	41.0	1.98	
Mar.	106.7	81.19	40.8	1.99	
Apr.	102.7	79.60	40.2	1.98	
May	102.2	79.80	40.1	1.99	
June	101.2	81.81	40.7	2.01	
July	98.6	82.62	40.7	2.03	
Aug.	102.9	83.84	41.1	2.04	
Sept.	104.4	85.08	41.1	2.07	
Oct.	107.4	86.10	41.0	2.10	
Nov.	107.0	85.05	40.5	2.10	
Dec.	105.8	84.03	40.4	2.08	
1958					
Jan.	129.5	80.94	39.1	2.07	
Feb.	123.8	80.32	38.8	2.07	
Mar.	120.2	79.87	38.4	2.08	
Apr.	115.6	79.87	38.4	2.08	
May	113.4	80.29	38.6	2.08	

Source: BLS, United States Department of Labor.

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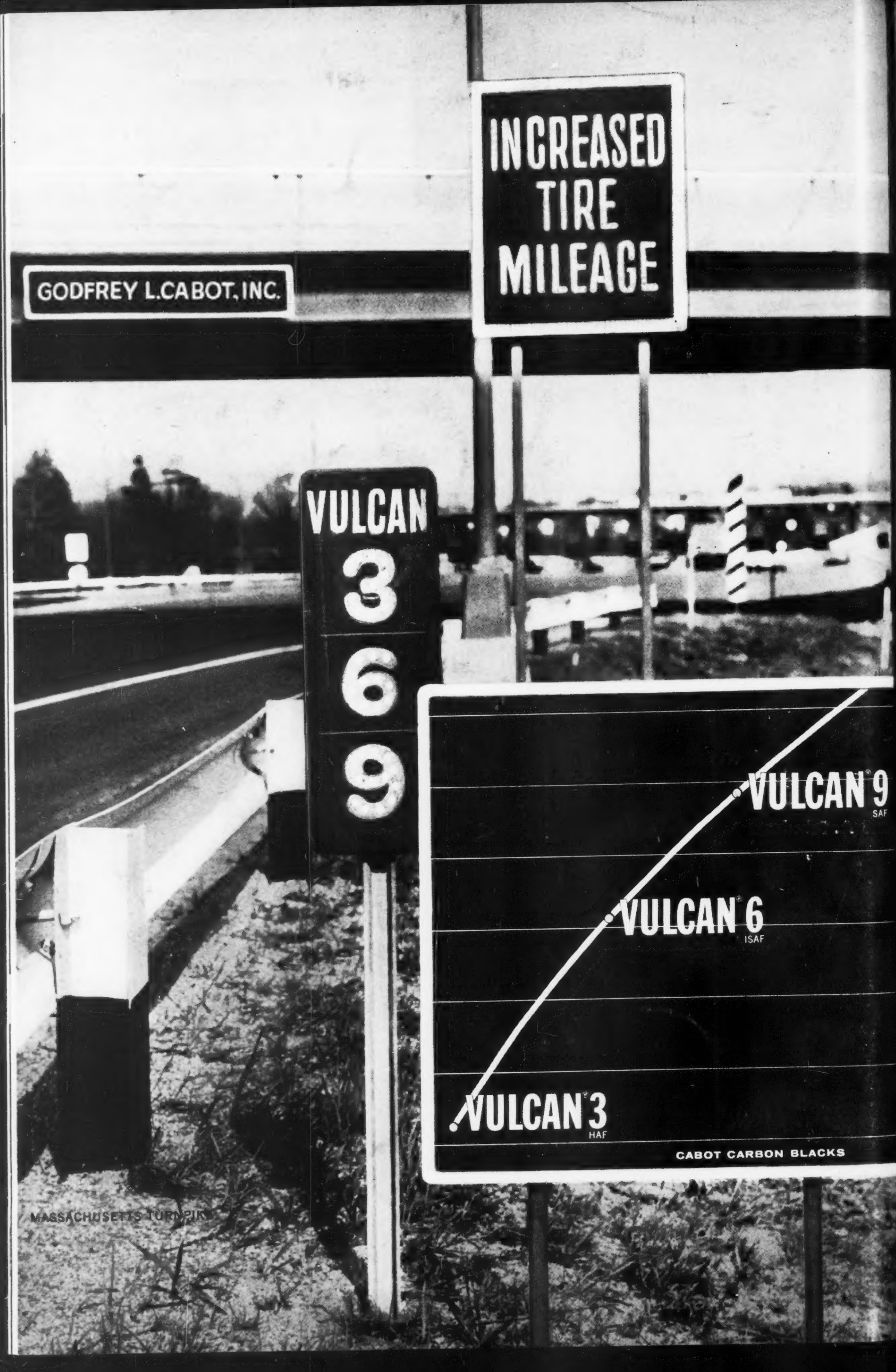

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